HARDWARE . . . . SOFTWARE . . . . AT HOME . . . . IN BUSINESS

computing today

FOR THE BUSINESS OF MICROCOMPUTING

NOVEMBER 1980
ISSN 0142-7210
60p

SPECIAL GRAPHICS ISSUE

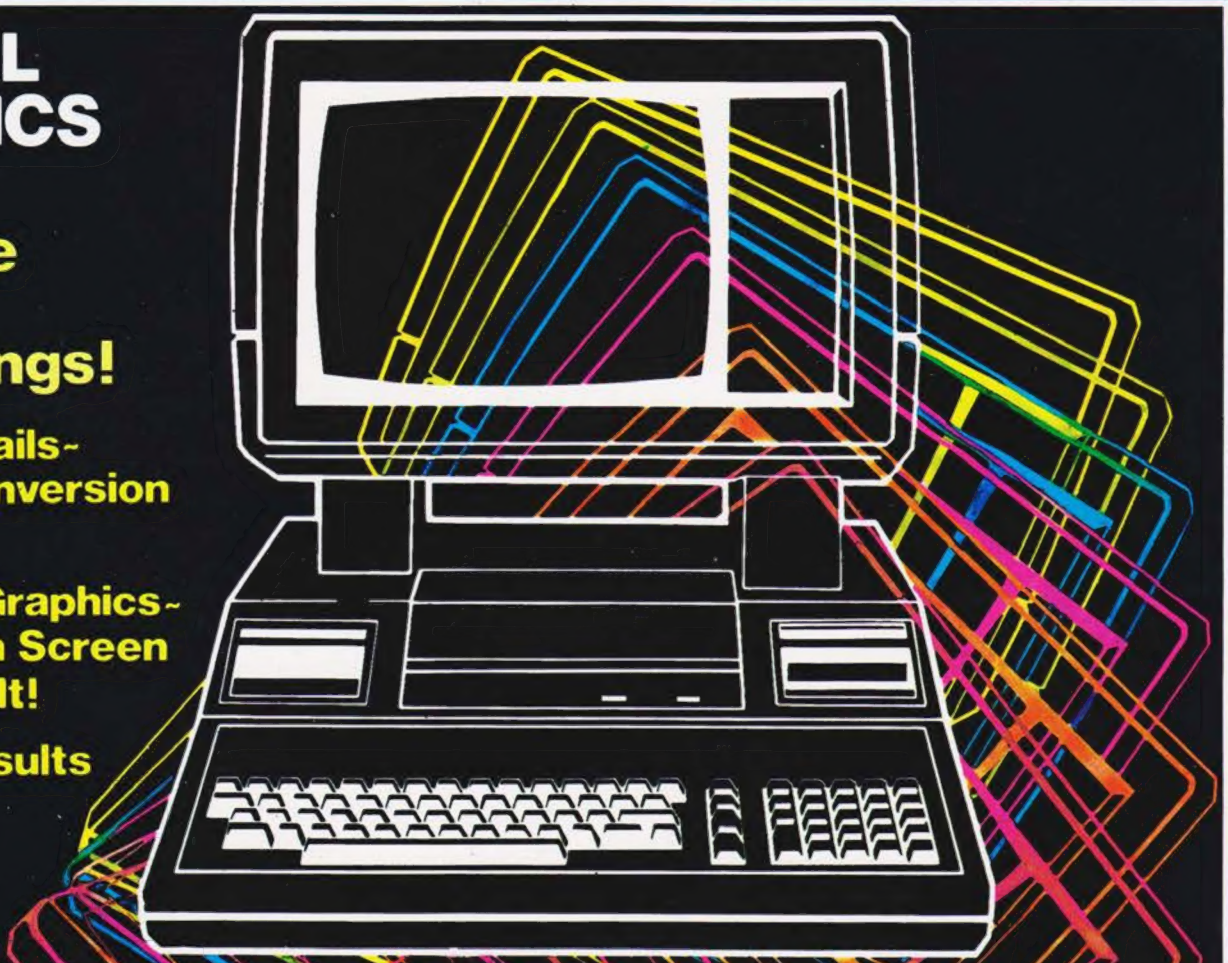
Put some life into your listings!

Graphic Details- Program Conversion Made Easy

Interactive Graphics- Putting It On Screen And Moving It!

Versatile Results Plotter For Business Or Home

Space Invasion Listing For 6502 Systems



CHOOSING A SYSTEM? SUPERB BUYERS GUIDE INSIDE

8K ON BOARD MEMORY!
5K RAM, 3K ROM or 4K RAM, 4K ROM (link selectable). Kit supplied with 3K RAM, 3K ROM. System expandable for up to 32K memory.

2 KEYBOARDS!
56 Key alphanumeric keyboard for entering high level language plus 16 key Hex pad for easy entry of machine code.

GRAPHICS!
64 character graphics option — includes transistor symbols! Only £18.20 extra!

MEMORY MAPPED
high resolution VDU circuitry using discrete TTL for extra flexibility. Has its own 2K memory to give 32 lines for 64 characters.

KANSAS CITY
low error rate tape interface.

SINGLE BOARD DESIGN
Even keyboards and power supply circuitry on the superb quality double sided plated through-hole PCb.

2 MICROPROCESSORS
Z80 the powerful CPU with 158 instruction, including all 78 of the 8080, controls the MM57109 number cruncher. Functions include +, —, *, /, squares, roots, logs, exponentials, trig functions, inverses etc. Range 10^{-99} to 9×19^{99} to 8 figures plus 2 exponent digits.

EFFICIENT OPERATION
Why waste valuable memory on sub routines for numeric processing? The number cruncher handles everything internally!

RESIDENT BASIC
with extended mathematical capability. Only 2K memory used but more powerful than most 8K Basics!

1K MONITOR
resident in EPROM.

COMPLETE KIT

NOW ONLY £225 + VAT

Cabinet size 19.0" x 15.7" x 3.3". Television not included in price.

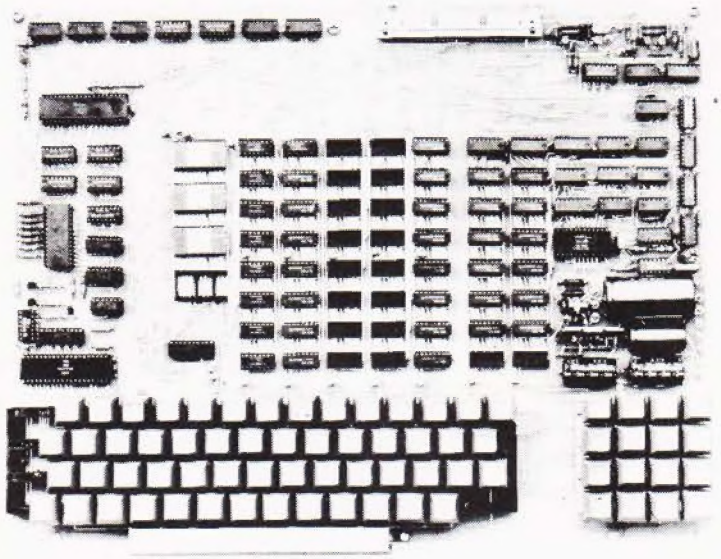
POWERTRAN

PSI Comp 80.Z80 Based powerful scientific computer Design as published in Wireless World

The kit for this outstandingly practical design by John Adams published in a series of articles in Wireless World really is complete! Included in the PSI COMP 80 scientific computer kit is a professionally finished cabinet, fibre-glass double sided plated-through-hole printed circuit board. 2 keyboards PCB mounted for ease of construction, IC sockets, high reliability metal oxide resistors, power supply using custom designed toroidal transformer. 2K Basic and 1K monitor in EPROMS and, of course, wire, nuts, bolts, etc.

KIT ALSO AVAILABLE AS SEPARATE PACKS

For those customers who wish to spread their purchase or build a personalised system the kit is available as separate packs eg. PCB (16" x 12.5") **£43.20.** Pair of keyboards **£34.80.** Firmware in EPROMS **£30.00.** Toroidal transformer and power supply components **£17.60.** Cabinet (very rugged, made from steel, really beautifully finished) **£26.50.** P.S. Will greatly enhance any other single board computer including OHIO SUPERBOARD for which it can be readily modified. Other packs listed in our FREE CATALOGUE.



PSI COMP 80 Memory Expansion System

Expansion up to 32K all inside the computer's own cabinet!
By carefully thought out engineering a mother board with buffers and its own power supply (powered by the computers transformer) enables up to 3 8K RAM or 8K ROM boards to be fitted neatly inside the computer cabinet. Connections to the mother board from the main board expansion socket is made via a ribbon cable.

Mother Board	Fibre glass double sided plated through hole P.C.B. 8.7" x 3.0" set of all components including all brackets, fixing parts and ribbon cable with socket to connect to expansion plug	**£39.50**
8K Static RAM Board	Fibre glass double sided plated through hole P.C.B. 5.6" x 4.8"	**£12.50**
	Set of components including IC sockets, plug and socket but excluding RAMs.	**£11.20**
	Complete set of board, components, 16 RAMS	**£89.50**
8K ROM Board	Fibre glass double sided plated through hole P.C.B. 5.6" x 4.8"	**£12.40**
	Set of components including IC sockets, plug and socket but excluding ROMs	**£10.70**
	2708 ROM (8 required)	**£6.00**
	Complete set of board, components, 8 ROM's	**£68.50**

Value Added Tax not included in prices

PRICE STABILITY: Order with confidence. Irrespective of any price changes we will honour all prices in this advertisement until December 31, 1980, if this month's advertisement is mentioned with your order. Errors and VAT rate changes excluded.

EXPORT ORDERS: No VAT. Postage charged at actual cost plus £1 handling and documentation.

U.K. ORDERS. Subject to 15% surcharge for VAT. No charge is made for carriage. *Or current rate if changed.

SECURICOR DELIVERY: For this optional service(U.K. mainland only) add £2.50(VAT inclusive)per kit.

SALES COUNTER: If you prefer to collect kit from the factory, call at Sales Counter. Open 9 a.m.-12 noon, 1-4.30 p.m. Monday-Thursday.

POWERTRAN ELECTRONICS

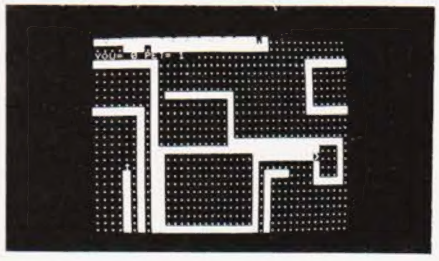
PORTWAY INDUSTRIAL ESTATE
ANDOVER HANTS SP10 3MN
ANDOVER (0264) 64455

CONTENTS

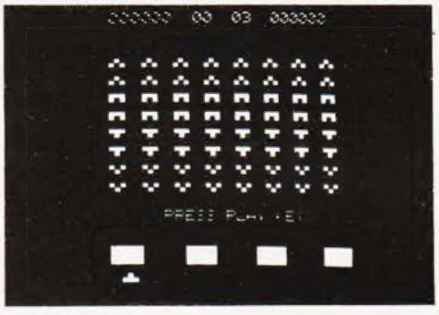
VOL 2 No 9 NOVEMBER 1980

EDITORIAL & ADVERTISEMENT OFFICE
145 Charing Cross Road, London WC2H 0EE.
Telephone 01-437-1002 – 7. Telex 8811896

Editor : Ron Harris B.Sc.
Assistant Editor : Henry Budgett
Editorial Assistant : Tina Boylan
Group Art Editor : Paul Wilson-Patterson
Drawing Office Manager : Paul Edwards
Group Advertisement Manager : Christopher Surgenor
Advertisement Manager : Bill Delaney
Managing Director : T.J.Connell



Micro motion p.13



Repel the raiders p.34

More for your money p.64

Computing Today is normally published on the second Friday in the month preceding cover date.
Distributed by: Argus Distribution Ltd, 12-18 Paul Street, London. 01-247 8233.
Printed by: Alabaster Passmore & Sons Ltd, Maidstone, Kent.

Subscription Rates : UK £10 including postage. Airmail and other rates upon application to CT Subscriptions Service, MAP Publications, PO Box 35, Bridge Street, Hemel Hempstead, Herts.

Britain's first com computer kit.

The Sinclair ZX80.

£79.95

Price breakdown
ZX80 and manual: £69.52
VAT: £10.43
Post and packing FREE

Please note: many kit makers quote VAT-exclusive prices.

You've seen the reviews... you've heard the excitement... now make the kit!

This is the ZX80. 'Personal Computer World' gave it 5 stars for 'excellent value.' Benchmark tests say it's faster than all previous personal computers. And the response from kit enthusiasts has been tremendous.

To help you appreciate its value, the price is shown above with and without VAT. This is so you can compare the ZX80 with competitive kits that don't appear with inclusive prices.

'Excellent value' indeed!

For just £79.95 (*including* VAT and p&p) you get everything you need to build a personal computer at home... PCB, with IC sockets for all ICs; case; leads for direct connection to a cassette recorder and television (black and white or colour); *everything!*

Yet the ZX80 really is a complete, powerful, full-facility computer, matching or surpassing other personal computers at several times the price.

The ZX80 is programmed in BASIC, the world's most popular computer language for beginners and experts alike.

The ZX80 is pleasantly straightforward to assemble, using a fine-tipped soldering iron. It immediately proves what a good job you've done; connect it to your TV... link it to an appropriate power source*... and you're ready to go.

Your ZX80 kit contains...
- Printed circuit board, with IC sockets for all ICs.
- Complete components set, including all ICs – all manufactured by selected world-leading suppliers.
- New rugged Sinclair keyboard, touch-sensitive, wipe-clean.
- Ready-moulded case.
- Leads and plugs for connection to domestic TV and cassette recorder. (Programs can be SAVEd and LOADed on to a portable cassette recorder.)
- FREE course in BASIC programming and user manual.

Optional extras
- Mains adaptor of 600 mA at 9 V DC nominal unregulated (available separately – see coupon).
- Additional memory expansion boards allowing up to 16K bytes RAM. (Extra RAM chips also available – see coupon).

*Use a 600 mA at 9 V DC nominal unregulated mains adaptor. Available from Sinclair if desired (see coupon).

The unique and valuable components of the Sinclair ZX80.

The Sinclair ZX80 is not just another personal computer. Quite apart from its exceptionally low price, the ZX80 has two uniquely advanced components: the Sinclair BASIC interpreter; and the Sinclair teach-yourself BASIC manual.

The unique Sinclair BASIC interpreter offers remarkable programming advantages:
- **Unique 'one-touch' key word entry: the ZX80 eliminates a great deal of tiresome typing. Key words (RUN, PRINT, LIST, etc.) have their own single-key entry.**
- Unique syntax check. Only lines with correct syntax are accepted into programs. A cursor identifies errors immediately. This prevents entry of long and complicated programs with faults only discovered when you try to run them.
- Excellent string-handling capability – takes up to 26 string variables of any length. All strings can undergo all relational tests (e.g. comparison). The ZX80 also has string input – to request a line of text when necessary. Strings do *not* need to be dimensioned.
- Up to 26 single dimension arrays.
- FOR/NEXT loops nested up to 26.
- Variable names of any length.
- BASIC language also handles full Boolean arithmetic, conditional expressions, etc.
- Exceptionally powerful edit facilities, allows modification of existing program lines.
- Randomise function, useful for games and secret codes, as well as more serious applications.
- Timer under program control.
- PEEK and POKE enable entry of machine code instructions. USR causes jump to a user's machine language sub-routine.
- High-resolution graphics with 22 standard graphic symbols.
- All characters printable in reverse under program control.
- Lines of unlimited length.

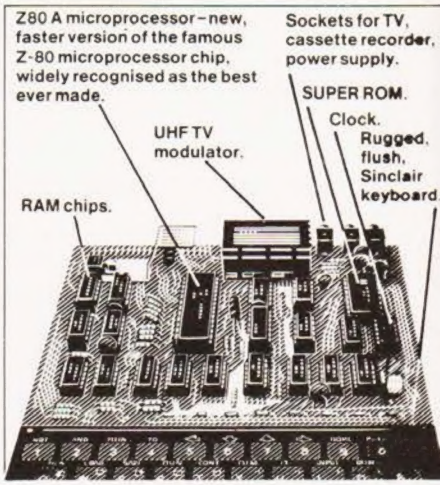
Fewer chips, compact design, volume production – more power per pound!

The ZX80 owes its remarkable low price to its remarkable design: the whole system is packed on to fewer, newer, more powerful and advanced LSI chips. A single SUPER ROM, for instance, contains the BASIC interpreter, the character set, operating system, and monitor. And the ZX80's 1K byte RAM is roughly equivalent to 4K bytes in a conventional computer – typically storing 100 lines of BASIC. (Key words occupy only a single byte.)

The display shows 32 characters by 24 lines.

And Benchmark tests show that the ZX80 is faster than all other personal computers.

No other personal computer offers this unique combination of high capability and low price.

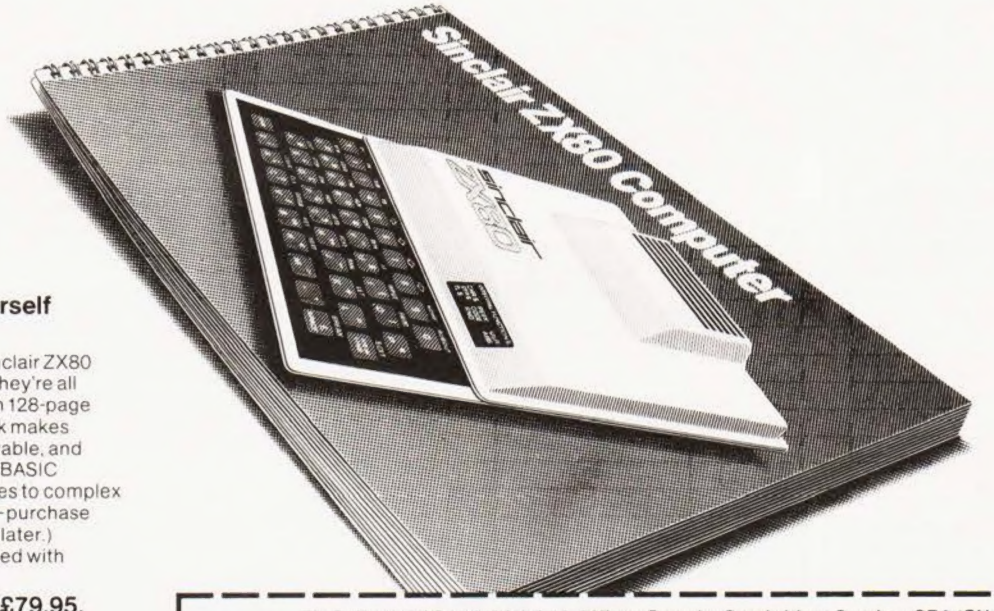


plete

ZX80 software – now available!

See advertisements in Personal Computer World, Electronics Today International, and other journals.

New dedicated software – developed independently of Science of Cambridge – reflects the enormous interest in the ZX80. More software available soon – from leading consultancies and software houses.



The Sinclair teach-yourself BASIC manual.

If the specifications of the Sinclair ZX80 mean little to you – don't worry. They're all explained in the specially-written 128-page book free with every kit! The book makes learning easy, exciting and enjoyable, and represents a complete course in BASIC programming – from first principles to complex programs. (Available separately – purchase price refunded if you buy a ZX80 later.) A hardware manual is also included with every kit.

The Sinclair ZX80. Kit: £79.95. Assembled: £99.95. Complete!

The ZX80 kit costs a mere £79.95. Can't wait to have a ZX80 up and running? No problem! It's also available, ready assembled and complete with mains adaptor, for only £99.95.

Demand for the ZX80 is very high: use the coupon to order today for the earliest possible delivery. All orders will be despatched in strict rotation. We'll acknowledge each order by return, and tell you exactly when your ZX80 will be delivered. If you choose not to wait, you can cancel your order immediately, and your money will be refunded at once. Again, of course, you may return your ZX80 as received within 14 days for a full refund. We want you to be satisfied beyond all doubt – and we have no doubt that you will be.

sinclair ZX80

Science of Cambridge Ltd

6 Kings Parade, Cambridge, Cambs., CB2 1SN.
Tel: 0223 311488.

ORDER FORM

To: Science of Cambridge Ltd, 6 Kings Parade, Cambridge, Cambs., CB2 1SN.
Remember: all prices shown include VAT, postage and packing. No hidden extras.
Please send me:

Quantity	Item	Item price £	Total £
	Sinclair ZX80 Personal Computer kit(s). Price includes ZX80 BASIC manual, excludes mains adaptor	£79.95	
	Ready-assembled Sinclair ZX80 Personal Computer(s). Price includes ZX80 BASIC manual and mains adaptor	£99.95	
	Mains Adaptor(s) (600 mA at 9 V DC nominal unregulated)	8.95	
	Memory Expansion Board(s) (each one takes up to 3K bytes)	12.00	
	RAM Memory chips – standard 1K bytes capacity	16.00	
	Sinclair ZX80 Manual(s) (manual free with every ZX80 kit or ready-made computer)	5.00	
NB. Your Sinclair ZX80 may qualify as a business expense.		**TOTAL**	£

I enclose a cheque/postal order payable to Science of Cambridge Ltd for £_____

Please print

Name: Mr/Mrs/Miss_____

Address_____

CT/11/80

HANDY TANDY

Tandy, the High Street electronics shop, are to sell a re-packaged version of the Sharp PC1211 that we reviewed in September. Prices are quoted as £119 including VAT but excluding the cassette adaptor for which you will have to fork out another £17.95. They have also developed a range of software packages, currently eight of them, which will cost from £8.95 to £13.95. It is more than likely that you could use these on your Sharp as well. The Sharp version will have an optional printer available soon, according to sources in the UK but it is not expected to arrive until the end of the year.

TANTEL — THE TRUTH

There have been some rumours appearing in print recently, about a forthcoming Prestel adaptor which are, to say the least, vague and contradictory. We approached the apparent source of these stories, Tangerine Computer Systems, and asked them for a definitive statement that would settle all the current speculation. The text that follows is their replv.

"The slow moving wonder of British Telecom — Prestel — will shortly receive the support it so richly deserves. Tangerine Computer Systems have taken the lead and produced a Prestel adaptor which is not only low-cost but can actually be manufactured in high volume. It is the volume that has frightened off many would-be manufacturers with the demand likely to exceed one million units over the next five years! Tangerine Computer Systems have capitalised on this, and by combining their unquestionable technical ability with the resources of the largest private company in the UK, have solved the problem.

'TANTEL', as it is known, will be available from January 1981 and will sell to the trade for around £125. The first production batch is for 20,000 units, with 50,000 the target for 1981.

A major attraction of 'TANTEL' is that it expands in simple, inexpensive stages to become a powerful home computer."

Further details are available upon written application to Tangerine Computer Systems at Forehill, Ely, Cambridgeshire.

FANGS TO KOBRA!

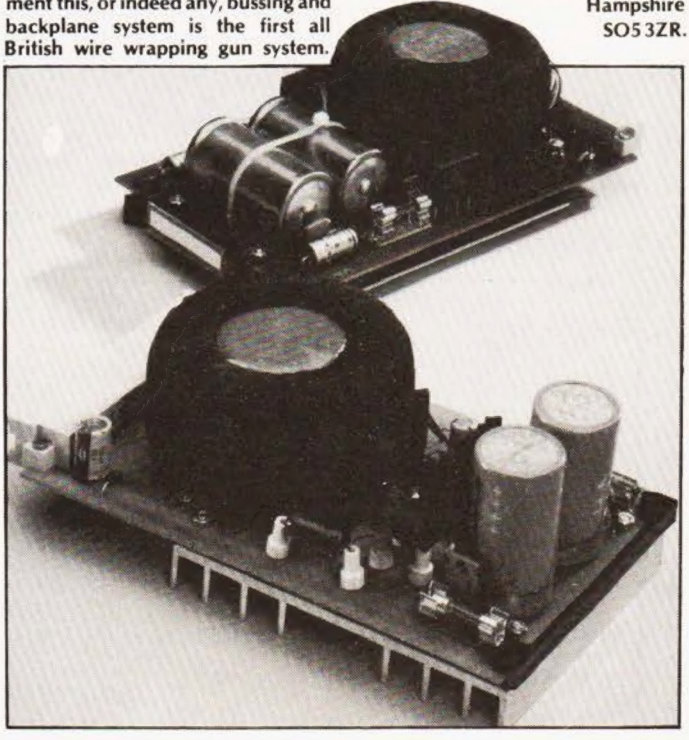
If you are in the fortunate position of owning several PETs but don't have the capital to give each of them a disc unit, why don't you take a look MUPET? This ingenious little box connects up to eight PETs to one Commodore disc unit, a saving of around £1,700. The units are approved by Commodore so you will have no warranty problems. Installation is simplicity itself with each IEEE connector going to a terminal connector and these are daisy chained to the MUPET controller which is connected to the 2040 disc unit. The standard configuration for three PETs cost £595 and each extra module costs £125. An additional feature of the system is that you can also share a printer unit, the additional package for this costs £210 and is available as an add-on only. Other recently introduced products include a dual function indicator for the 3040 disc unit which replaces the existing error LED and a hardware reset and break key for any model of 'NewROM PET', both cost £15.95. For details of these and many other PET related goodies contact Kobra Microsystems at 14 The Broadway, West Ealing, London W13 0SR or give them a ring on 01-579 5845.

CORE OF THE MATTER

Microsense, the UK importer for Apple products, have just published a free booklet which purports to list 'all programs for Apple'. It includes a wide and varied list of software that is available from both it and its various distributors but appears to omit sources like the ACT Appleware catalogue and the many other independent sources. Still, it's free and can be obtained from Microsense Computers, FREEPOST, Finway Road, Hemel Hempstead, Herts HP2 7PS or ring on 0442-48151 and ask for your copy.

VERO SUPPLY

Vero Electronics, the people with a thousand and one products for the electronics person, are moving slowly but surely into the personal computer market. Among their launches so far this year have been racks for both NASCOM and Tangerine computer systems and the S100 sub-rack system. They have now just launched a 5 V at 5 A power supply unit to fill a gap at the top of the Eurocard supply range. This would be ideal for many of the new card based micros that fit into the standard 3U frames such as KM4C. Also recently announced is a microcomputer backplane system for a full 19" rack based system. Only two out of the 96/96 connector ways are dedicated but there is provision for 0 V screen between each of the 83 possible signal lines. And to complement this, or indeed any, bussing and backplane system is the first all British wire wrapping gun system. Available as a professional tool at around £43, excluding bit, or as a commercial quality unit complete with bit and integral un-wrap facility at around £40 for a complete kit. The gun works off rechargeable cells and performed remarkably well under test — an excellent tool for the money and British to boot. The final trumpet fanfare is for an interesting modular VDU chassis which can accommodate two sizes of monitor and two sizes of keyboard. The smaller sized screen has provision for a mini floppy disc unit and it is more than likely that your micro could be 'desktopped' into one of these at a not unreasonable price. For information on all these goodies contact Vero Electronics at Industrial Estate, Chandlers Ford, Hampshire SO5 3ZR.



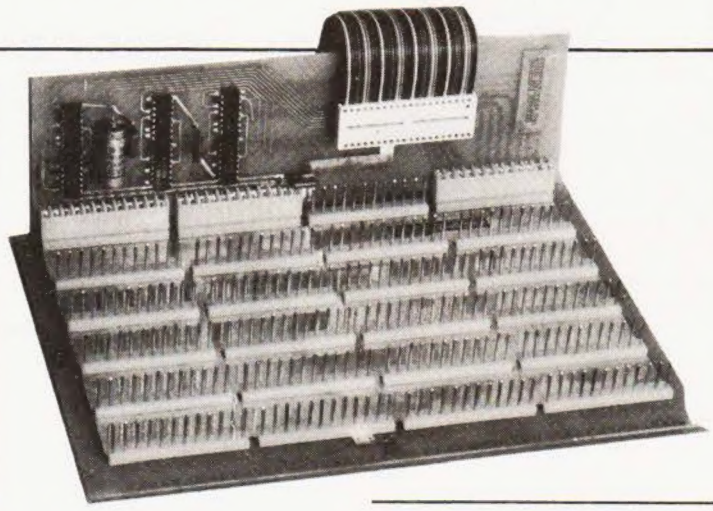
CLUB CALL

It's nearly a year now since we last published our computer club survey and things are changing out there. Latest information on the activities is as follows, Atom users have an independent, but Acorn supported, User Group now. This is run by R.G. Meredith of Sheerwater, Yealm View Road, Newton Ferrers, South Devon and it costs £4 a year. A new club is being founded in the Northants area around Towcester by R.J. Wellstead and anyone in that area who is interested should contact him at 20 Hampton Court Close, Abbey Chase, Towcester. The Scottish Amateur Computer Society have had a change of venue and now meet on the first Wednesday of each month in the Claremont Hotel, Claremont Crescent, Edinburgh at 7.30. Anyone interested should contact the Club Secretary, Alastair Macpherson at 6 Curriehall Castle Drive, Balerno, Edinburgh 14. MACRO, that's the Medway Amateur Computer and Robotics Organisation, now meet monthly and have a subscription of £3. For details contact Mrs Christine Webster, 13 Ladywood Road, Cuxton, Rochester, Kent. The Cleveland Micro-computer Users Group has split into two groups, Adults meet on the third Tuesday each month and the Juniors meet every second Tuesday. The new address of the Secretary is 13 Weston Crescent, Norton, Cleveland. Computer fans in West London have yet another club in their area. Run by Graham Brain of 81 Rydal Crescent, Perivale, Middlesex they meet on the first Tuesday of each month at the Willesden Technical College. Finally, the National TRS-80 Users Group is running yet more of its workshops with the next one in Cambridge on Saturday 29th November. For full details contact the Secretary at 40a High Street, Stony Stratford, Milton Keynes.

NEWS

IN TRIPLICATE?

With the MZ-80K moving into the business marketplace by introducing both disc and printer units it was inevitable that business software would start to emerge. One of the first packages has come from Tridata and is a full payroll system for up to 400 employees. The package conforms to the Inland Revenue specification and can cater for hourly, weekly and monthly paid staff as well as overtime rates and pension scheme payments. The cost of the hardware is around £2,000 with a further £250 for the software. Full details can be had from any of the Sharp dealerships or direct from Tridata at Smithfield House, Digbeth, Birmingham B5 6BS.



UK MOTHERS

Owners of the Superboard/UK101 computers will be interested to hear of a new buffer/motherboard introduced by ZEN Computer Services. Costing £43.70 assembled and tested, it is available as a set of parts. The unit consists of two boards with a 40-way jumper to the main board and requires an extra power supply unit, the multi-rail NASCOM supply is ideal. For full details contact ZEN at 71 Manor Avenue, Sale, Cheshire M33 5JQ or ring on 061-962 3251.

BUSINESS IS LEISURE

Despite the recent troubles that have beset Nascom at least one of their suppliers has been sufficiently motivated to produce yet more support hardware. B & L Microcomputers have just announced a new case for a NASCOM 2 and up to four extra boards which will cost £45. The product is professionally finished with allowance for a full set of connectors, fan, power supply and other necessary extras already made. No more panel bashing here. They have also introduced a new interface called the 'Castle' which will provide full cassette handling and only costs £15, apparently a real bargain. As the final addition to the range they have produced a four channel analogue to digital converter for £50 which is aimed directly at the education market but will obviously be interesting to both the personal and scientific markets. For more details on all these products contact Business and Leisure Microcomputers at 16 The Square, Kenilworth CV8 1EB.

NANO ON COURSE

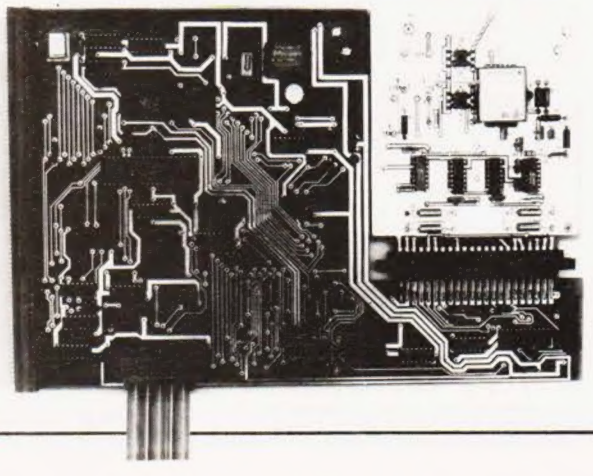
Using the Nanocomputer as an educational tool is by no means a new idea, after all that's exactly what it was designed for. This time however the students are people involved in industry and management who, according to a recent MORI survey, realise that they had better start learning about the micro now before it's too late. A series of five-day basic introductory courses has been set up by the University of East Anglia in conjunction with the Midwich Computer Company and they are recognised by the Department of Industry MAP scheme. Both residential and non-residential facilities are available at Norwich, the site of the University, and full details on them can be obtained either from the Course Registrar or from Midwich at 9 Churchgate Street, Old Harlow, Essex CM17 0JS. The Nanocomputer is also being distributed through the Byte shop chain giving it a greater national coverage.

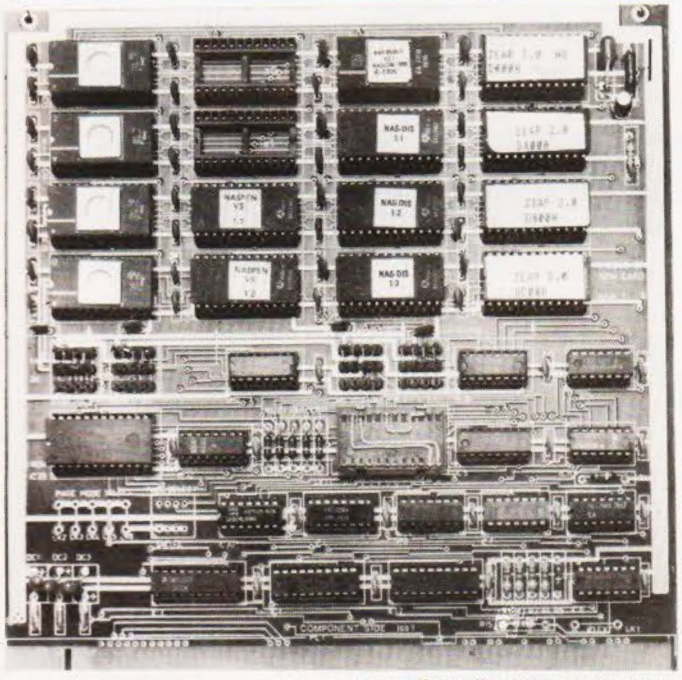
RAMMING IT HOME

Semiconductor memories are never satisfied with themselves. Mostek have just succeeded in producing a 2K by eight pseudo-static device that only needs + 5 V, uses one third the power of a currently available 16K by one dynamic device and needs no refreshing. Apparently all the internals are based on dynamic technology but there is a complete in-built refresh system that makes the chip look 'static' to the rest of the system. Currently available access times are 250 nS and 300 nS and the power requirements are 5 mA on standby and 30 mA operational. For data sheets contact Mostek (UK) Ltd., at Mansions House, 1 Valley Drive, Kingsbury Road, London. NW9 or ring on 01-204 9322.

BUBBLY NASCOMS

Owners of the NASCOM range of computers who worried about support for their machines during the recent upset at the parent company may be relieved to hear of yet another NASBUS compatible product. Introduced by Microdata Computers the new board is a bubble memory unit offering some 90K bits of storage organised as 144 loops of 641 bits, the average access time to the first bit of any loop is 4 mS. All the operating systems and initialisation software are built into a 2708 EPROM and the unit will be compatible with any of the NASCOM monitors. Also located on the same board is a real time clock. Further product information from the company at Belvedere Works, Bilton Way, Pump Lane, Hayes, Middlesex UB3 3ND. The telephone number is 01-848 9871.





PAGES ON PROM

Interface, the NASCOM distributors set up by the company before the financial troubles, have launched a significant new product for NASCOM users. It is a page mode PROM board that fills two urgent gaps in the market. Firstly it allows the user to benefit from the increasing amount of firmware and secondly it allows the NASCOM 1 owner to plug in the BASIC ROM as it has a 24 pin socket especially for this. Each board can carry 40K of firmware and is totally compatible with the NASBUS and costs £55 plus VAT. Full details of this and all their other products from Interface Components at Oakfield Corner, Sycamore Road, Amersham, Bucks HP6 6SU or ring on 02403-22307.

KEEP IT CLEAN

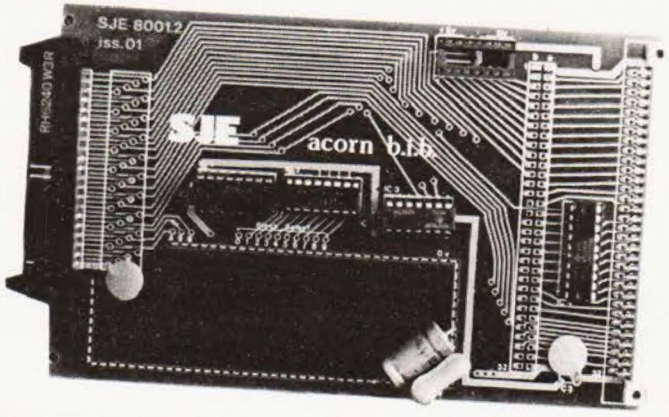
Have you cleaned your heads recently? The odds are that you haven't, so why don't you try the latest in cleaning discs. Designed to clean the heads of floppy discs whilst still in the drive units they look just like an ordinary disc except that they are made of a special white cleaning material which is soaked in fluid. They are available in both 5¼" and 8" sizes and the disc can be used about 26 times. There are two per pack which gives you one clean a week for a year. Also recently introduced by the same company is an alignment diskette that checks the track to head alignment and pinpoints adjustments to be made if errors are occurring. For details of both these products contact BFI Electronics at 516 Walton Road, West Molesey, Surrey KT8 0QF.

SOFTWARE BANK

Databank have launched a further five disc based programs for the ITT2020, Apple and PET customers. Among their range of seven business packages, two maths packages and nine games are the new Word Processor, Salesman, Graph Plot, Statistics and Crossword programs. Most programs cost £10 on the relevant disc, PET users can choose either CBM or Computhink format, or you can go for their 'bumper bundles' of any ten for £30. The Word Processor and Mailer/Letter packages cost £40 and £50 respectively but you get five other programs thrown in free. For details contact Databank at 66 Queens Road, Loughborough, Leicestershire LE11 1HD or give them a ring on 0509-217671.

AIM GOES NUTS

A marriage has been arranged between the AIM 65 and the Acorn, both of 6502 origin with long pedigrees. The bond has been formed around a new Bus Interface Board that plugs into the expansion port on the AIM and either acts as a two card 'mini motherboard' or plugs into a full Acorn backplane. Among the potential cards you can now access are the colour VDU, the disc interface and an IEEE-488 interface. Prices range from the minimum configuration at £33.00 to a fully buffered and tested version at £59.00. Further information is available from Kim Spence-Jones at S-J Engineering, 8F Oxford and Cambridge Mansions, Transept Street, London NW1 5EH or from Acorn Ltd, 4a Market Hill, Cambridge CB2 3NJ.



HOLY BITS

The US answer to the high-speed digital cassette, the Stringy Floppy, is being imported to the UK by MBS Terminals Ltd. The main advantages are the low cost and high speed, half the cost of a mini-floppy and ten times the speed of a cassette. The unit is based around a wafer, a continuous loop of chrome dioxide tape on a Mylar base, which is about the size of a business card and only 3/16th of an inch thick. All the necessary software is in ROM and the unit is available with RS232 or parallel interfaces as well as a variety of dedicated microcomputer versions for the TRS-80, PET and Apple. The expected UK price is around £200 which doesn't compare too well with the US price. MBS Terminals can be contacted at Aldwych House, Madeira Road, West Byfleet, Surrey. Those wishing to order direct from the US can contact the manufacturers, Exactron, at 3557 Ryder Street, Santa Clara, California 95051 or by ringing 408-737 7111, preceeded by the US code. Rumour has it that you can pay by Access (Mastercharge) and Visa and that the service for both information and orders is very good indeed.

SINCLAIR ADDS ON

The ZX80 has acquired some bolt-on extras in the form of a 16K RAM module and an 8K BASIC. The new BASIC ROM costs £19.95 and comes complete with a new keyboard overlay sheet and an extra manual describing its function. The interesting points to note are that it is incompatible with the existing 4K version which it supplements, you cannot buy the machine equipped with the 8K. You cannot load 4K programs off tape and run them under 8K, you'll have to completely re-enter them by hand. The 16K RAM module replaces the existing 3K unit and is actually cheaper at £49.95. The memory is dynamic, the refresh is done internally, but it overwrites the 1K memory contained within the unit. This should be no problem, you could even take the chip out and save a little power! Announced at the same time was the news that a US firm, Image Computer Products, have won the franchise for ZX80 software after the UK firm of ACT, parents of Petsoft, dropped out of the running. The deal means that software packages, all based around the 4K BASIC to begin with, will start to appear on both sides of the Atlantic. Catalogues detailing the range will be inserted into each ZX80 that is shipped, all business is still being done by mail-order. Clive Sinclair also stated that the earlier delivery problems had been solved and quoted one week for kits and four weeks for ready built versions. Sinclair also reckons to have shipped 17,000 units but no one would confirm whether this figure is 'orders taken' or 'orders delivered'.

HARDWARE . . . . SOFTWARE . . . . AT HOME . . . . IN BUSINESS

computing today

FOR THE BUSINESS OF MICROCOMPUTING

DECEMBER 1980
ISSN 0142-7210
60p

ON SALE AT YOUR NEWSAGENT 14th NOVEMBER

CELLS AND SERPENTS

A superb new role playing game, written in BASIC for implementation on most popular computers with 8K of memory. The basic framework can be expanded almost to the limits of your imagination, and the amount of memory in your machine. Battle to the death with all the evil little nasties that lurk within the coded game cells.

MORE ON MACHINE CODE

Could this be CT's ultimate book review? We take a leaf or two out of a new publication that we think is an ideal introduction to the world of personal computing.

BASIC STOCKMARKET

Remember back in June we published a Stockmarket game? Well, we have been inundated with versions in a variety of high-level languages. This month we present the best of those submissions programmed on an RML 380Z.

GRAPHICS PART TWO

In our continuing series of the use of graphics we turn to moving things under cursor control. Not only is it educational, it's fun as well!

ZX80 TIPS

Ideas are coming in thick and fast on ways to upgrade this popular machine. We print some of the best received so far.

Articles described here are in an advanced state of preparation. However, circumstances may dictate changes to the final contents.

COMPUTER CHESS GAME
ONLY £49.95

(+£2.05 p&p and insurance)

FOR BEGINNERS OR GRAND MASTERS!

Whatever your standard of chess play, you'll meet a rewarding opponent in Zetron's excellent Computer Chess Game with six different levels of skill.

Choose a degree of difficulty to suit your own cunning and then challenge the Chess Game's built-in micro-computer to an absorbing battle of wits.

Play the complete game or the survival game. Electronic sounds indicate the game status, and there's a unique illegal move check – so there can be no cheating.

Special moves:
*Promote a pawn *Castling *En passant

Special features:
*Cancel a move *Delete a piece *Insert a piece *Search a piece

AC/DC Operation (mains adaptor supplied).
12 months guarantee.

Dimensions: 9¼" wide x 6½" deep x 2¼" high.

MITRAD, 68-70 High Street, Kettering, Northants.
Tel: 0536 522024

To Mitrad, 68-70 High Street, Kettering, Northants

Please send me _____ Computer Chess Game(s) at £52 each (including £2.05 p&p and insurance).

Total value of my order £ _____

I enclose a cheque/PO or debit my Access/Barclaycard

No. _____ Signature _____

Name _____

Address _____

_____

_____

(block letters please)

☎ For immediate attention credit card holders may telephone (0536) 522024 twenty-four hours a day, stating card number. Delivery subject to availability. Please allow 14-21 days. Full refund if not completely satisfied.

(Chess set and table not included) Code: CT3

It's The Mu-pet Show

Multi-User PET (Mu-pet) links 3-8 PET computers to one Commodore disc drive and a printer.

Mu-pet is very good news indeed for those PET users wanting a multi-user computer system and who, up until now, have run up against a budgetary brick wall.

Mu-pet delivers the goods at very low cost... which is one of the reasons it's become the world's biggest selling multi-PET system. Precisely engineered in the U.S. and Canada, Mu-pet makes the most of PET computers – *without the need for program changes.*

£595 is all it costs for a standard Mu-pet system that links three PET computers to a single Commodore disc drive and a printer. The cost of linking more PET computers, up to a maximum of eight, is £125 for each addition.

All machines have access to the disc drive and printer. The hardware which all runs via the IEEE bus has been so well designed that each PET thinks the disc is its own, and priority depends on who gets there first.

If you've three or more PETS, then you need a Mu-pet to make the most of them.

Yes, I want to see the Mu-pet show – please advise me on my nearest dealer.

Name _____

Address _____

_____

_____

KOBRA MICROSYSTEMS
14 The Broadway
West Ealing London W13 0SR
01-579 5845

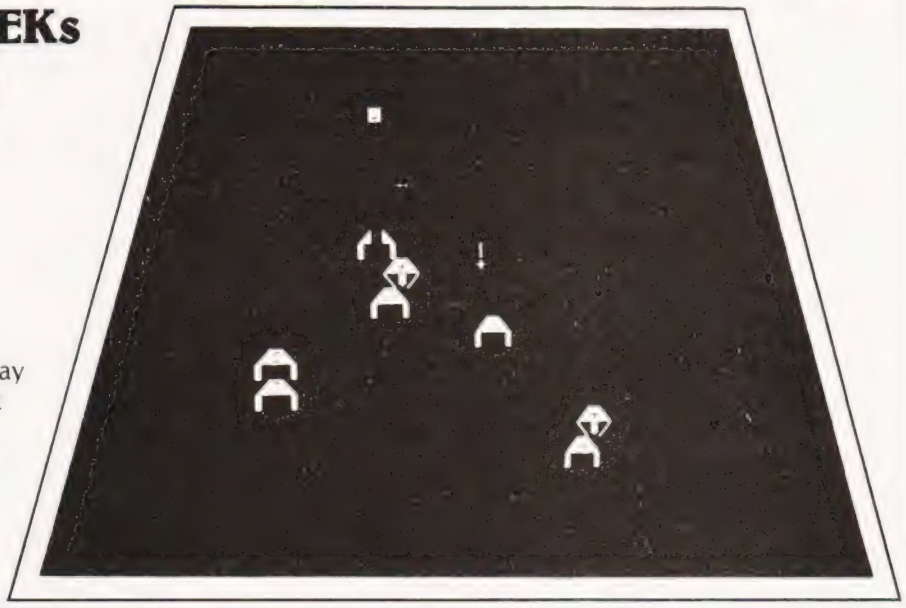
CT1

KOBRA

Trevor Lusty

INTERACTIVE GRAPHICS

The ins and outs of PEEKs and POKEs or how to bring your screen to life. Do away with static displays and move it a little.



Getting things to move on a video display is not so very difficult, when you think about it. It's surprising that we ever manage to keep anything stationary. After all, you're actually watching a moving spot which crosses the screen 625 times every 1/25 of a second. Now, if your monitor is 12 inches wide (I do so love these SI units) that's 625x25 ft/sec which is over 21000 MPH!

Memory mapped video is a display system in which each character position on the screen is actually a memory location. A unique function of this block of memory is that it is accessed by both the processor and the video circuitry. The memory assigned to video is constantly scanned to refresh and update the screen, and consequently, any change in a location value is immediately visible. We shall be using the PEEK function to look at the values in these memory locations and the POKE function to change them.

Any video display which uses a memory mapped technique is capable of producing simple graphics, and the programs contained in this article are examples of various possibilities. They should work with any computer which has PEEK and POKE statements and uses this type of display.

A Random Start

Before we actually begin, it is important to realise some of the dangers. Indiscriminate POKEing is likely to spell instant disaster! Find out the value, base 10, of the memory address of the top left-hand corner of your screen, the number of characters per line, and the number of lines per page. I have assigned the following variables to these values:-

SP = Screen Pointer
(PET = 32768, TRS80 = 15360 etc.)
LL = Line Length
(PET = 40, RM 380Z = 64 etc.)
PL = Page Length
(PET = 25, TRS80 = 16 etc.)

Set up these values according to your system and you should have few problems. The value of the address for a position X spaces across and Y lines down may be calculated as SP + Yx LL + X. OK. —— enter and run the following program. Remember —— my values are for a PET.

```
10  SP=32768:LL=40:PL=25
20  FOR J=0 TO 255
30  POKE SP, J
40  NEXT J
```

All the characters available should have appeared in quick succession in the top left-hand corner of the screen. If this does not happen check to the value for SP. Now, that wasn't very helpful, so let's try to space the characters out a bit. Change line 30 to POKE SP+J,J and re-run the program. The characters should be on the top few lines of the screen, but the RM 380Z will not display all the characters using this method, as there is some addressing conflict on the right-hand edge of the screen.

We are now ready for our first mind-blower. The following program POKEs random characters to random positions on the screen —— try it and see:-

```
10  SP=32768:LL=40:PL=25
20  FOR I=1 TO 1000
30  RL=INT(PL*RND(1))
40  RP=INT(LL*RND(1))
50  POKE SP+RL*LL+RP, INT(256*RND(1))
60  NEXT I
```

You should now have characters splattered all over the screen. What we need now is to bring some order to this apparent chaos.

A New Kind Of Art

The first thing to do is to choose a character from those available. I have found the reverse of the space key to be the most suitable, this has a screen code of 160 on the PET. (Your value may be different.) Enter the following program with a code number which works for you:-

```
1000  SP=32768:LL=40:PL=25
1020  PRINT CHR$(147)
1100  POKE SP+4*LL+4, 160
```

The CHR$(147) is to clear the screen, and when you run this program the result should be a single white blob in the top left-hand quadrant. Add the following lines of code and re-run the program:-

```
1120  POKE SP+4*LL+(LL-5), 160
1140  POKE SP+(PL-5)*LL+4, 160
1160  POKE SP+(PL-5)*LL+(LL-5), 160
```

The result this time should be four blobs symmetrically placed on the screen. The diagram (Fig.1) shows how the addresses are calculated in order to achieve this effect:-

Remember that the top line of the screen is line zero, and the left-hand column is column zero. Adding four blank lines

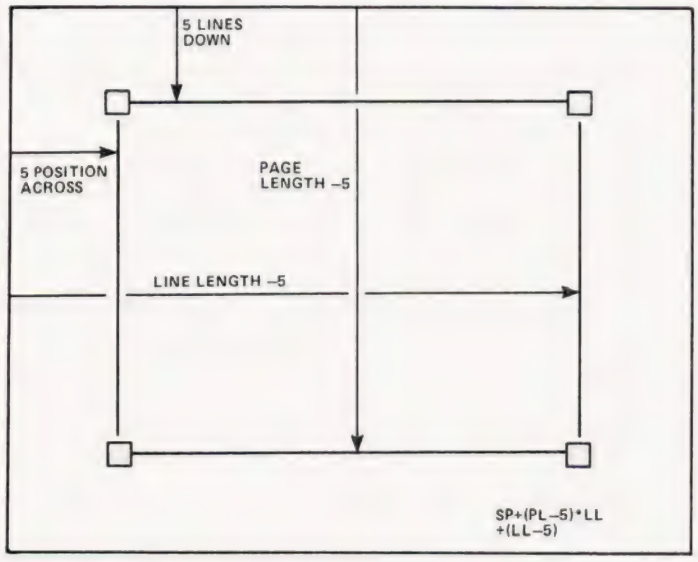
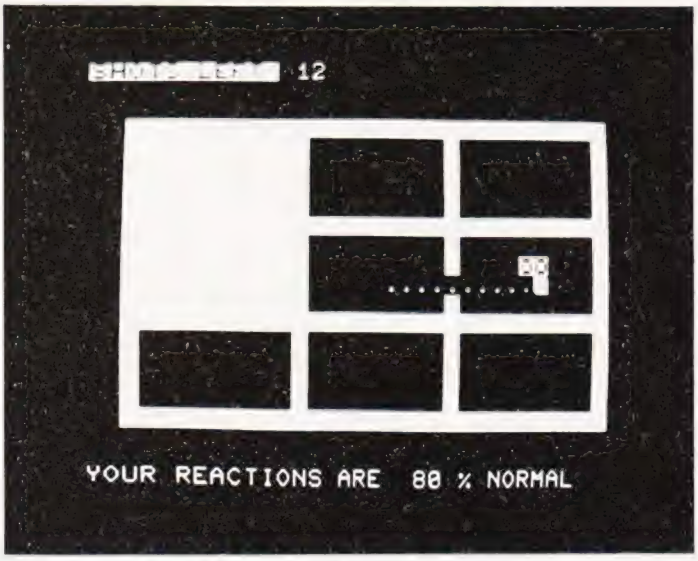


Fig.1. How to calculate character positions on the screen.



A symmetrically placed grid is used as the play area in the game of WUMPUS.

at the top of the screen therefore puts us on the fifth line down. This explains why five must be subtracted from the page and line lengths in order to obtain a symmetrical result.

You are now ready for 'BLOTCH' which is listed below. This program POKEs a symmetrical pattern to the screen and then after a short pause continues with a new display. Lines 1200 to 1260 show how to POKE a string of characters to the screen. The +64 in line 1240 produces reverse video on the PET, you might have to leave it out.

```
 100 REM ** 'BLOTCH'
 120 REM ** POKING SYMMETRICAL
 140 REM ** PATTERNS
 160 REM ** CHANGE SP, LL & PL
 180 REM ** FOR YOUR MACHINE
1000 SP=32768:LL=40:PL=25
1020 HL=INT(LL/2):HP=INT(PL/2):PRINT CHR$(147)
1040 FOR I=1 TO 150
1060 LET X=INT(RND(1)*(HL+2)):Y=INT(RND(1)*
     (HP+2))
1080 LET X=INT(RND(1)*X):Y=INT(RND(1)*Y)
1100 POKE SP+Y*LL+X,160
1120 POKE SP+Y*LL+(LL-X-1),160
1140 POKE SP+(2*HP-Y)*LL+X,160
1160 POKE SP+(2*HP-Y)*LL+(LL-X-1),160
1180 NEXT I
1200 W$="BLOTCH"
1220 FOR X=1 TO LEN(W$)
1240 POKE SP+HP*LL+HL-1+X-LEN(W$)/2,
     ASC(MID$(W$,X,1))+64
1260 NEXT X
1280 FOR I=1 TO 5000:NEXT I
1300 RUN
```

'BLOTCH' weights the address numbers towards the corners using lines 1060 and 1080. However, if the result is still too random for you, try the following program. This has a much more mathematical flavour and produces a real piece of modern art. Line 1050 may be omitted by non-PET users, it merely demonstrates another way of getting the title onto the screen.

```
1000 SP=32768:LL=40:PL=25
1010 FOR I=SP TO SP+PL*LL:POKE I,160:NEXT I
1020 FOR LI=0 TO PL-1
1030 POKE SP+LI*LL+(INT(6*RND(1)+1)*INT
     (6*RND(1)+1)),32
1040 NEXT LI
1050 PRINT "[HOM][REV]CUBISM[CD][6CR]U
     [CD][CL]B[CD][CL]I[CD]
     [CL]S[CD][CL]M[OFF]"
1060 FOR PI=0 TO LL-1
1070 POKE SP+LL*(INT(5*RND(1)+1)*INT(4*RND
     (1)+1))+PI,32
1080 NEXT PI
1090 GOTO 1020
```

Getting Things Moving

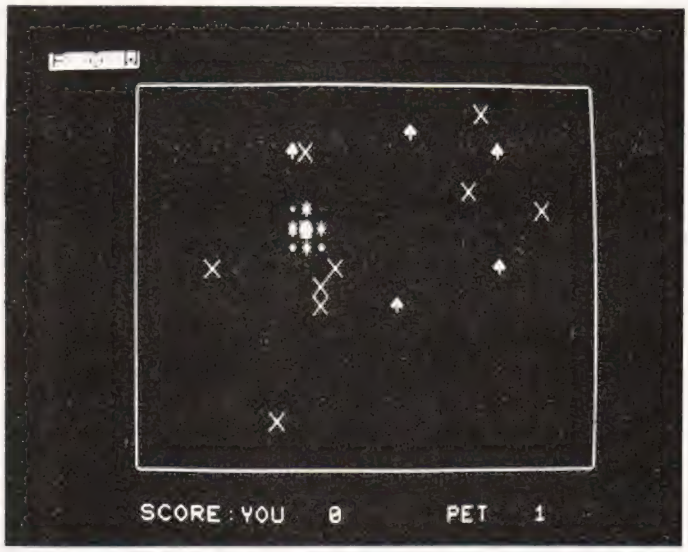
So far, so good — — we can now make patterns appear before our eyes, but as yet, we have no illusion of movement. Think of the Blackpool illuminations, and the way they make a static line of bulbs appear to move. Let's try to emulate that effect. For each bulb we will use an asterisk ("*") for which the POKE code is 42. Enter and run the following program:-

```
150 SP=32768:LL=40:PL=25:PRINT CHR$(147)
160 FOR J=10 TO LL-10
170 POKE SP+J,42
180 NEXT J
```

Well there's our line of bulbs — — not very exciting yet. Add the following code to your program and re-run it.

```
190 FOR J=10 TO LL-10 STEP 2
200 POKE SP+J,32
210 NEXT J
```

The last piece of code has switched some of the lights off because 32 is the ASCII code for a space. Now we will try to be clever. We will work our way along the line of bulbs, moving



Another old favourite, CHASE, uses a fixed play area in which you move around avoiding unpleasant death.

the pattern one position to the right. Add this coding and re-run the program:-

```
220  T2=PEEK(SP+LL-10)
230  FOR J=10 TO LL-10
240  T1=PEEK(SP+J)
250  POKE SP+J,T2
260  T2=T1
270  NEXT J
```

Can you see the way variable T2 is used to make the pattern loop back on itself? All we have to do now is add:-

```
280  GOTO 230
```

and the trick is complete — — try it and see.

The following program incorporates the above techniques to illustrate how they might be used to bring the screen to life. I thought of the name 'ENTOMB' as I was writing it, I think you'll agree that it's quite apt. Here is the complete listing, and the explanation follows:-

```
200  SP=32768:LL=40:PL=25:PRINT CHR$(147)
210  FOR J=0 TO PL-1
220  POKE SP+J*LL,160
230  POKE SP+J*LL+LL-1,160
240  NEXT J
250  FOR J=0 TO LL-1
260  POKE SP+J,160
270  POKE SP+24*LL+J,160
280  NEXT J
290  REM ** SET STARTING POSITION
300  REM ** AND DIRECTION VECTORS
310  X=INT(LL/2):Y=INT(PL/2)
320  P=SP+Y*LL+X:X1=1:Y1=LL
330  REM ** CHANGE DIRECTION IF
340  REM ** WE ARE BLOCKED
350  IF PEEK(P+Y1)=160 THEN Y1=-Y1
360  IF PEEK(P+X1)=160 THEN X1=-X1
370  P=P+X1+Y1:POKE P,42
380  IF (P=P6) AND (P=P2) THEN END
390  REM ** ADJUST LENGTH AND
400  REM ** POKE THE OBSTACLES
410  P7=P6:P6=P5:P5=P4:P4=P3:P3=P2:P2=P1:
     P1=P
420  POKE P7,32
430  POKE SP+1000*RND(1),160
440  POKE SP+LL*(1+INT((PL-2)*RND(1)))+
     (LL*RND(1)),32
450  GOTO 350
```

'ENTOMB' may be entered and run in stages. Let's start with lines 200 to 280. These lines clear the screen and set up the border. Type in the program up to this point and run it to ensure that it works correctly. This is most important as we will be using the border to keep our asterisk snake confined, and if it gets loose you might be POKEing in some unfortunate places.

Make sure you understand the following piece of arithmetic gymnastics before you proceed further. In order to give the illusion of movement we must be able to move vertically, diagonally or horizontally from any position on the screen, but our only reference to our present position will be a POKE number P. What values must be added or subtracted to this number for the required movement? The solution is fairly easy, to move right one position add one, to move left subtract one. To move vertically down we add a whole line length and to move up we subtract this value. Diagonal movement requires a combination of these two movements, as Fig.2 shows:-

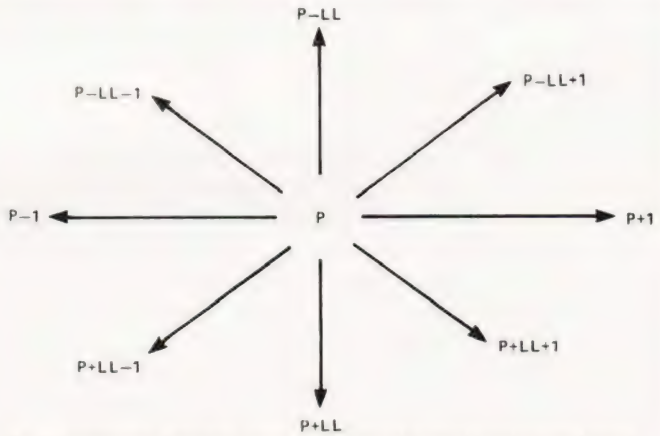


Fig.2. Movement direction from any given point can be calculated quite simply.

X1 and Y1 are used to store the required increments, and direction may be changed by changing the sign of one or both of these variables. Lines 350 and 360 show how we can look ahead in the direction of motion and change direction if we hit the border. Type in the program up to line 370, add line 450 and run the program again.

The result should be an ever increasing string of asterisks which appear to bounce off the border surrounding the screen. Use the 'break' key to stop the program as it is in an infinite loop. You would be well advised to store temporary copies of your program as you go along, just in case the ravenous ever-growing monster which you have just created escapes and plonks asterisks through main memory!

Some limit on the length of our snake is required, and this is achieved by lines 410 and 420. These lines store previous positions for the head and POKE a space when the head has moved seven spaces. Insert these lines into your program and you'll see what I mean.

The program is completed by line 430 which adds extra obstacles to the screen, line 440 which gives the snake a chance to escape and line 380 which stops the program when the snake is in danger of disappearing up its own posterior. The program continues until the poor snake is entombed in a mass of white blobs.

Making It Faster

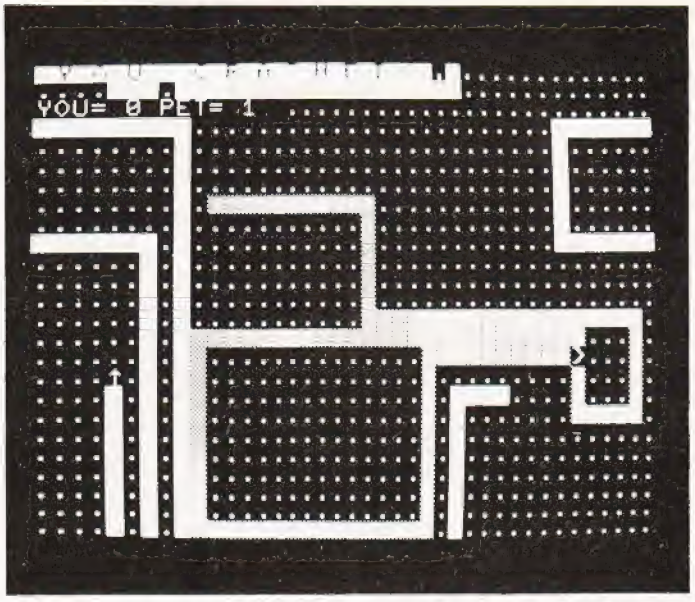
As you add more coding and try to make more things move at the same time, things gradually get slower. This can be overcome in two ways, either by improving your BASIC coding or by using machine code. The following program is an example of how a little thought will speed up your BASIC:-

```
100 SP=32820:LL=40
110 FOR K=1 TO 5
120 FOR L=1 TO 20
130 POKE SP+K*LL+L-2,32
140 POKE SP + K*LL + L - 1,46
150 POKE SP+K*LL+L,42
160 NEXT L
170 POKE SP+K*LL+L-2,32
180 POKE SP+K*LL+L-1,32
190 NEXT K
200 REM ** THE SAME BUT
210 REM ** MUCH FASTER
220 FOR K=1 TO 5:Y=SP+K*LL:FOR L=1 TO 20:
    X=Y+L
230 POKE X-2,32:POKE X-1,46:POKE X,42
240 NEXT:POKE X-1,32:POKE X,32:NEXT
```

The POKEing techniques should now be familiar to you, but note how the second section is condensed and how unnecessary calculations are removed. When you run this program you will see just how much faster the second version is. The coding for the second section is much more difficult to understand, so I suggest that you only use this technique to speed up an already working program.

There are times, however, when BASIC just isn't fast enough. Imagine that you are on the Enterprise when the Klingons attacks, POKEing a few blobs on the screen is just not dramatic enough. What we would like to do is to reverse the whole screen a couple of times to simulate an explosion. This requires a machine code routine. My problem here is that not all machines use the same processor or have the same memory map, but the following routine shows how this effect can be achieved on a PET.

```
033A                1  ! REVERSE SCREEN ROUTINE
033A                2  !
033A                3  ! 6502 ASSEMBLER LISTING
033A                4  ! FOR THE PET
033A                5  !
0001                6  SCREEN=1
033A                7  !
033A  A2 80         8  LDX # $80
033C  86 02         9  STX SCREEN+1
033E  A9 00        10  LDA # $00
0340  85 01        11  STA SCREEN
0342  CA           12  LOOPA DEX
0343  A0 00        13  LDY # 00
0345  B1 01        14  LOOPB LDA (SCREEN),Y
0347  49 80        15  EOR # $80
0349  91 01        16  STA (SCREEN),Y
034B  C8           17  INY
034C  D0 F7        18  BNE LOOPB
034E  E6 02        19  INC 02
0350  E0 7C        20  CPX # $7C
0352  D0 EE        21  BNE LOOPA
0354  60           22  RTS
0355               23  .END
```

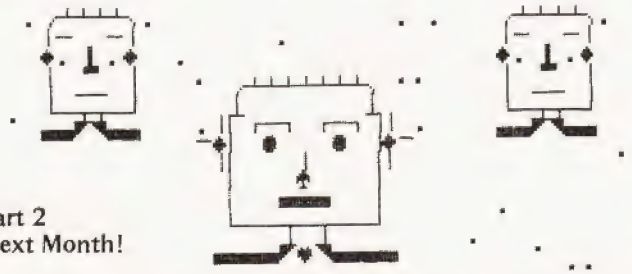


SURROUND, a game that uses the movement calculations referred to in the text.

The code resides in the PET's second cassette buffer, but it is relocatable. The routine may be called using a SYS(826) statement, and may be easily incorporated into a BASIC program using the following loader.

```
100 FOR I=826 TO 852:READ J:POKE I,J:NEXT I
110 DATA 162,128,134,2,169,0,133,1,202,160,0,177,1,
    73,128
120 DATA 145,1,200,208,247,230,2,224,124,208,238,
    96
```

Well that's all we have space for this time. I am conscious that I have not said anything about true animation, movement under cursor control, the use of the PLOT (SET) function or double density graphics. Watch this space for further exciting instalments!



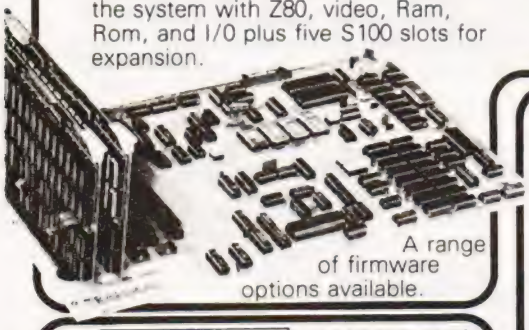
Part 2 Next Month!

NEW THE TUSCAN S100

A Z80 based S100 Computer System.

Available in Kit Form or Assembled. All components available separately.

TUSCAN main board. The heart of the system with Z80, video, Ram, Rom, and I/O plus five S100 slots for expansion.



A range of firmware options available.

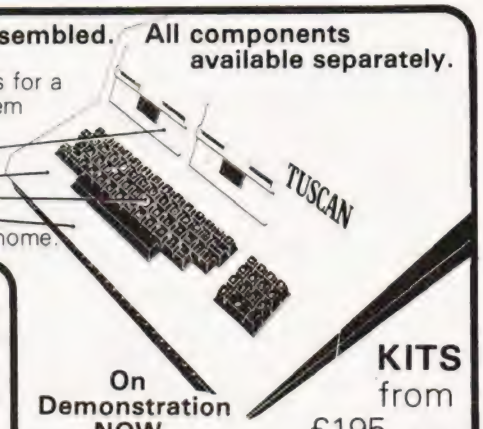
Houses two 5¼" drives for a compact business system

Profeessional case will house the complete system

Two keyboard options

Hinged lid for easy access

Stylish finish ideal for office or home.



On Demonstration NOW

KITS from £195 + VAT delivery Ex-Stock

NASCOM PRODUCT LIST + VAT

I/O board kit less I/O chips	45.00
UART + BAUD rate generator + crystal for I/O board	16.00
Econographics kit for additional 128 characters (N1 only)	30.00
2708/2716 Programmer suitable for N1 and N2 under NAS-SYS	£20.95 plus VAT
Nascom 19" rack mounting card frame for N1 and N2	32.50
Nas-DA disassembler 3 EPROM for Nas-sys	37.50
MK36271 8K BASIC in 8K x 8 ROM	40.00
Naspen VS in 2 EPROM	30.00
Nas-sys monitor in 2 EPROM	25.00
4 Games Tape	£6.50
Nasbug T4 2 x EPROM	25.00
Tiny Basic 2 x EPROM	25.00
Super Tiny Basic 3 x EPROM	37.50
Super Tiny Basic upgrade 1 x EPROM	12.50
Tape Software	
ZEAP 2 tape and documentation for Nas-sys	30.00
8K BASIC tape and documentation for N1	15.00

nascom-2 MICRO-KIT COMPUTER WITH IMPROVED 16k B RAM Board

Ex-stock

only £335 + VAT

Full after sales service

Firmware & MOS ICs Software

Zeap Assembler (4, 1Kx8 EPROMS) £50

Nas Pen text editor (2, 1Kx8 EPROMS) £30

Expansion boards (in kit form)

48K RAM £210 ● 32K RAM £175.00

16K RAM £140

EPROM CARD (NASCOM compatable) KIT. Suitable for 16 x 2708 or 16 x 2716 or mixed 1 x NASCOM 8k BASIC ROM £55.00. New BASIC programmers aid. Self locating tape £14.95.

POWER SUPPLY £29.50

THE HENELEC DISK SYSTEM FOR NASCOM and any other Z80 - 8080 Microcomputer with an uncommitted P10

DISKS

● The Henelec controller card plugs direct into a Z80 P10 and controls up to **3 double-sided mini-floppy drives giving a maximum 480K system.**

● **General Purpose FDC control software for simple DOS or for CPM.**

● **Simple DOS software for NASCOM 1/2 under NAS-SYS**

● **OR** ROM CB10S for CPM on NASCOM 1/2 incorporating the major NAS-SYS features. Maximum 60K CPM system.

● New MD prom supplied for N2/CPM

TWO SYSTEMS

● SIM-DOS "Floppy Tape Recorder" with 1 drive PSU firmware, etc. £335 plus VAT

● CPM System with 1 drive PSU firmware, etc. £395 plus VAT

● Additional Drives with PSU £255 plus VAT

TANGERINE

COMPUTER SYSTEMS

"MICRON" the latest line in superb products on demonstration from your London stockist

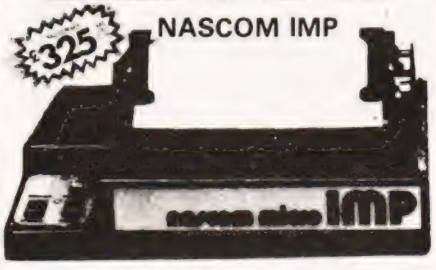
EX-STOCK

£395.00 inc. VAT BRITISH DESIGN

- 6502 based microcomputer
- VDU alpha numeric display
- Powerful monitor TANBUG
- 8K RAM
- 32 parallel I/O lines
- 2 serial I/O lines
- RS 232 C/20mA loop, with 16 programmable Baud rates
- Four 16 Bit counter timers
- CUTS cassette recorder interface
- Data bus buffering
- Memory mapping control
- 71 Key ASCII Keyboard, including numeric keypad and with auto repeat
- Including metal cabinets for both keyboard and modules
- Including power supply 10K Microsoft BASIC

Ideal for NASCOM – PET – TRS80 – TRITON

NASCOM IMP



PLAIN PAPER PRINTER £325

Fully built and housed in a stylish enclosure for just **£325** plus VAT.

INTERFACES WITH ALL MICRO COMPUTERS

The Nascom IMP (Impact Matrix Printer) features are

60 lines per minute. 80 characters per line.
● Bi-directional printing. ● 10 line print buffer.
● Automatic CR/LF. 96 character ASCII set (including upper/lower case, $, £). ● Accepts 8½" paper (pressure feed). ● Accepts 9½" paper (tractor feed). ● Tractor/pressure feed. Baud rate from 110 to 9600. ● External signal for optional synchronisation of baud rate.

IDEAL FOR WORD PROCESSING

COMPUTER KEYBOARDS

APPLE COMPUTER KEYBOARD

52 Key 7 Bit ASCII coded Positive Strobe +5V – 12V. Size 13x4¾". Sturdy Construction. Sloping Keys. Black/White print. Made in USA for Apple Inc. **Brand New £35 incl VAT.** Post £2.50 Individually packed in ANTI-STATIC FOAM.

71 KEY ASCII KEYBOARD INCLUDING NUMERIC KEYPAD. £49.00 plus £7.35 VAT TOTAL £56.35. Uses gold crosspoint keys. Includes keypad and ribbon cable. Only available as fully assembled and tested.

STAR DEVICES MK III 71 keytouch sensitive keyboard. With numeric pad. All ASCII characters including control keys. Auto key repeat. Parallel output with strobe. Shift lock with indicator LED. Built in 'beeper' with level control. 5V DC at 300mA 15" x 7" x 1.25". Grey case with white keys on blue. 48.50 plus VAT

CARTER 57 key ASCII keyboard. Conventional key board. 128 ASCII characters including control keys. Parallel output with strobe. Shift lock. + 5 V and —12 V DC. 12" x 5.5" x 1.5". Black keys with white ledgends. 39.34 + VAT.

FERRANTI – "SIZE 14 x 6 x 3" SLOPING FRONT" 55 Key ASCII Coded in steel case. Complete with Plug and Cable with circuit to convert to T.T.L. levels. In good condition at only **£19.95** + VAT, P/P £2.50

CENTRONICS QUICK PRINTER

List Price £459 incl. VAT

OUR PRICE plus VAT

EXCLUSIVE TO HENRY'S 50% OFF MAKER'S PRICE £195

for: **TANDY, PET, NASCOM**

Software selectable 20, 40 and 80 column using 120mm aluminium-ised paper. 1 roll supplied. 150 lines per minute.
Centronics parallel data interface for Nascom, Tandy, etc.
240 volt mains input. ASCII character set
Paper feed, and on/off select switches
'BELL' signal Weight 10lbs
Size: 13" x 10½" x 4½".
New, boxed and fully guaranteed

POST PAID **Price £195.00** + VAT

See *COMPUTING TODAY* Recommendations MARCH/MAY ISSUES

MEMORIES Discounts 10% for 4, 15% for 8, 20% for 16

MK3880 (NZ80)	7.50	2708	5.95
MK3880-N4 (Z80A)	7.95	2716	15.00
MK4116 16K x 1 dy RAM	6.50	IM6402 UART	4.50
MK4027 4K x 1 dy RAM	2.25	2114 1K x 4 Static RAM	3.25
2102 1K x 1 static RAM	1.00	8080A	5.25
4118 1K x 8 static RAM	12.75		

TANGERINE LONDON STOCKISTS

Microtan 65 Kit, Incl. VAT £79.35

Microtan 65 Assembled, £90.85

Tanex (min. con) Kit, Incl. VAT	£49.45
Tanex Assembled Incl. VAT	£60.95
Lower case pack, Incl. VAT	£10.90
Chunky Graphics Pack, Incl. VAT	£7.50
20 Way Keypad Incl. VAT	£11.50
Mini-mother board Incl. VAT	£9.95

Complete Tangerine range available

SEND FOR COMPLETE COMPUTER BROCHURE FREEPOST TO ADDRESS BELOW

London Tangerine TUSCAN and NASCOM DISTRIBUTOR

Export Orders deduct VAT, but add 5% carriage

Official Export & Educational Orders welcome

Our Telex 262284 Mono Ref. 1400 Transonics

ADD VAT 15% TO YOUR ORDER EXCEPT WHERE STATED

HENRY'S

Computer Kit Division

404 Edgware Road, London, W2, England I.E.D.

01-402 6822

COMPUTECH for apple

COMPUTECH for ITT

Well proven software (several hundred packages already licensed) for business applications on the ITT 2020 and Apple microcomputers.

Prices excluding V.A.T for cash with order, F.O.B London NW3

PAYROLL	(300+ Employees, 100 Departments, hourly, weekly, monthly. Very powerful but easy to use).	£375
SALES LEDGER	(500+ Accounts, 100 Departments).	£295
PURCHASES LEDGER	(500+ Accounts, 100 Departments).	£295
GENERAL (OR NOMINAL) LEDGER	(1000 Accounts, 100 Analyses, multi-purpose package).	£295
UTILITIES DISK 1	(Diskette patch, slot to slot copy, zap etc).	£20
APPLEWRITER	(Word Processing)	£42
VISICALC	(Financial Modelling, Costing, Analysis)	£95

AND NOW HARDWARE!

COMPUTECH DIPLOMAT H/S SERIAL INTERFACE **£80**

This card has been designed and built to the same professional standards that have resulted in the success of our software. The DIPLOMAT observes the proper "handshaking" protocol so that you can drive fast printers and send and receive data from other peripherals at high speeds without loss of data. Switch (& software) selectable baud rates to 19200 and many other options. Plug compatible with 'terminal' or 'modem' wired peripherals. Guaranteed.

MICROLINE M80 PRINTER **£450**

This very reliable printer now available from us ex. stock. Driver in machine code to enable both text and graphics, 40, 80 and 132 clear characters on 8 inch line, sprocket and friction feed standard, optional tractor. Parallel interface card for Apple/ITT 2020 only £80. Trade enquiries welcome.

THE FABULOUS MICROMUX 8000 **from £800**

This is a brand new product, an asynchronous serial multiplexor with up to 16 ports, any of which may communicate with any other independently, like a 'telephone exchange' for data! Built in test function. Firmware may be customised for special applications. Available in multiples of 4 ports up to 16.

COMPUTECH SYSTEMS

168, Finchley Road, London NW3 6HP. Tel: 01-794 0202

AGENTS THROUGHOUT THE UK AND OVERSEAS

PET EDITOR

S. Kemp

The program is designed for a PET and how it could be adapted for any other computer I have no idea! If you have a PET without printout, have you never found yourself with a long program edited beyond recognition from the original draft and want to find some special place in the listing? You guess it's about line 600 and type "List 500-600" and get about four lines of program on the screen. No, it isn't there, try "List 600-700", this time 20 lines of program come up and six of them scroll off the top of the screen — and so on.

This routine will output your program listing in order, one page at a time.

Append To Use

First you will want to tack this program on the end of the one you are writing, well out of the way and starting at an easy to remember line number (say 40,000). Here are some explanatory notes to be read in conjunction with the listing:

Line No

39990 A wise precaution to prevent running your main program into the edit program.

40020 Input the line number where you want to start. Obviously if you want to start at the beginning then line 1 is the line number to enter.

40040 N is the key to the memory location that contains the next line number and 1025 is the first memory location available for your program and will thus hold information about your first program line.

40040 M is the counter which ensures you get nine lines only on each "page". Any more than nine lines and you could risk scrolling up and off the screen. Since N relates to the memory location of the *NEXT* line it is constantly being changed. We want to save the location of the first line number of each set of nine for future use hence N1 = N.

40040 Every line of program in the memory starts with the location of the next line followed by its own line number. X1 is the line number of this line and is found by PEEKing at (N + 3) and (N + 2) memory locations, N is the first memory location of the next line and is found by PEEKing (N + 1) and (N).

40060 If the line number you have found (X1) is smaller than the start line number(s) then we loop back carrying on new value of N and look at the next line until a line number equal to or greater than the start line number if found.

40065 The final line of your program says that the next line is in location N = 0 so when this happens you want to skip out the cycle and not risk crashing into the machine memory.

40070 The first of the nine line numbers to be listed will be called X.

40080 Increase the counter (M) by one and go round again until counter gets to nine.

40090 The last of the nine line numbers to be listed will be called Y.

40100 You have now put on the screen all the information that you don't want to lose.

N is the memory location for the *next* line number after the nine you are actually going to display.

X is the line number of the *first* line number to be displayed and Y is the line number of the *last* number to be displayed.

The GOTO statement will tell PET what to do when you have finished with the nine lines on display.

40110 You have now printed on the screen (2 lines down from the top) the magic words that you were typing in the first place (e.g. LIST 600-701) the only trouble is PET doesn't know it — YET!

40120 This little bit of POKE says: HOME CURSOR, CURSOR DOWN TWICE, CARRIAGE RETURN THROUGH THE LINE THAT SAYS "LIST 600-701" AND DO IT. The rest of the screen will now be filled with the nine lines of your program starting with 600 and finishing with 701 (obviously these line numbers are for example only) and the word READY.

N.B. At this stage you may edit these nine lines to your hearts delight, you may add extra lines as well providing that you don't scroll off the top of the screen. If you want to delete the READY to give yourself more room you may.

When you are satisfied with the screen full of lines on display, hit HOME CURSOR followed by CARRIAGE RETURN.

You have now gone to the top of the page, read the information that you did not want to forget and re-entered the program at line 40130.

40130 Now if you have edited the last page then the chances are that memory location N does not now hold the secret of the next line number so we must check back using N1. We must not lose N1 so we call it N2 and find the memory location of the next line after the ninth line.

40140 If no editing took place then N2 will equal N so we can go back to M = 0 and sort out the next nine lines.

40150 If N2 does not equal N then we correct the value of N and print out the last nine lines again but with the edited changes included.

All this sounds very complicated but the real test is in the reduction of key work. To list your complete program finger work is reduced to RUN 40000
then HOME — CR — HOME — CR — etc until all has been revealed.

Program Listing

```
39990 E N D
40000 PRINT "[CLS] PROGRAM LISTING — NINE LINES TO THE PAGE."
40005 PRINT "[CD] YOU MAY START AT ANY LINE NUMBER OF YOUR CHOICE."
40010 PRINT "[CD] TO START AT BEGINNING ENTER 1."
40020 INPUT " START LINE NUMBER"; S
40030 N = 1025
40040 M = 0: N1 = N
40050 X1 = 256* PEEK (N + 3) + PEEK (N + 2): N = 256* PEEK (N + 1) + PEEK (N)
40060 IF X1 < S THEN 40040
40065 IF N = 0 THEN M = 9: GOTO 40090
```

```
40070  IF M=0 THEN X=X1
40070  M=M+1: IF M<9 THEN 40050
40090  IF M=9 THEN Y=X1
40100  PRINT "[CLS] N="; N; ":N1="; N1;": X="; X;
       ":Y="; Y;:": GO TO 40130
40110  PRINT "LIST"; X; "-";Y
40120  POKE 623, 19: POKE 624, 17: POKE 625, 17: POKE
       626, 13: POKE 158, 4: END
40130  N2=N1: FOR M=1 TO 9: N2=256 x PEEK (N2+1)
       + PEEK (N2): NEXT M
40140  IF N2=N THEN 40040
40150  N=N2: GOTO 40100
```

MOUSETRAP

C. Archer

Mousetrap is a game of skill in which you have to trap the mouse in its cage in the minimum possible time. The game is written in TRS-80 Level II Basic and full instructions appear in the program in lines 380 onwards. These instructions should be typed in exactly as shown to produce a neat output when displayed.

Program Description

The operation of the program can be broken down into several small stages of a few lines each. Lines 20 & 30 decide if instructions are required, lines 50, 60 & 70 print out the board and the cage for the mouse, while line 80 places the player and the mouse randomly on the board. Line 100 checks if the mouse is in its cage. If it is and it remains there for more than 25 moves, about 3 seconds, then it assumes it is trapped and the game ends.

Lines 120 to 200 check if the mouse has hit a boundary and if so alters its course. 220 to 260 decide which keys are pressed, it scans the keyboard directly, and moves your position accordingly. Finally lines 280 to 350 print out messages for the end of the game, including your score, and compares your score with the previous best.

Program Listing

```
10  CLS: PRINT @ 10, CHR$ (23);"**** MOUSETRAP
    ****";;PRINT@454, "DO YOU WANT
    INSTRUCTIONS?"
20  M$=INKEY$:IF M$="" THEN 20
30  IF M$="Y" GOSUB 370 ELSE IF M$<>"N" THEN
    20
40  DEF INT A-Z:W=9999
50  R=0:CLS:V=0:FOR X=0 TO
    127:SET(X,0):SET(X,47):
    NEXT
60  FOR Y=0 TO 47:SET (0,Y): SET(127,Y): NEXT
70  FOR X=0 TO B:SET(X,5): NEXT
80  X=RND (126):Y=RND(46):A=1:B=1:
    M=RND(126): N=RND(46):SET(M,N):Z=126: D=46
90  P=X:Q=Y
100 IF X>9 OR Y>5 THEN J=0 ELSE J=J+1: IF
    J=25 THEN 280
110 G=PEEK (14400): IF G AND 121 THEN 220
120 V=V+1:PRINT@120,V;:SET(X,Y):IF
    POINT(X+A,Y+B)THEN 130 ELSE
    X=X+A:Y=Y+B:RESET(P,Q):SET(X,Y):GOTO 90
130 A1=A:A2=B:RESET (X,Y):IF POINT
    (X,Y+B)THEN B=-B
140 IF POINT(X+A,Y) THEN A=-A
150 IF NOT POINT(X+A,Y+B) THEN 100
160 A=-A1:B=-A2:IF NOT POINT(X+A,Y+B)
    THEN 100
170 A=A1:B=A2:IF NOT POINT(X+A,Y) THEN
    X=X+A:GOTO 100
180 IF NOT POINT(X,Y+B) THEN Y=Y+B:GOTO 100
190 IF NOT POINT(X-A,Y) THEN X=X-A:GOTO 100
200 IF NOT POINT(X,Y-B) THEN Y=Y-B:GOTO 100
210 R=1:GOTO 280
220 IF G AND 64 THEN IF M<Z THEN
    M=M+1:SET(M,N):GOTO 260
230 IF G AND 16 THEN IF N<D THEN
    N=N+1:SET(M,N):GOTO 260
240 IF G AND 8 THEN IF N>1 THEN
    N=N-1:SET(M,N):GOTO 260
250 IF G AND 32 THEN IF M>1 THEN
    M=M-1:SET(M,N)
260 IF G AND 128 THEN RESET(M,N)
270 GOTO 120
280 FOR B=1 TO 8
290 PRINT@800,"--GAME OVER--";:FOR X=1 TO
    200:NEXT
300 PRINT@801,"                ";:FOR X=1 TO
    200:NEXT:NEXT
310 CLS:PRINT@10,CHR$(23);"****
    MOUSETRAP****";
320 IF R=1 PRINT@132,"BOUNCING DOT COULD
    NOT MOVE -2000 POINTS
    PENALTY";:V=V+2000
330 PRINT@458,"YOUR SCORE
    ";V;:PRINT@522,"BEST SCORE";
340 IF V<W PRINT "YOURS";:W=V ELSE PRINT W;
350 PRINT@900,"PRESS ENTER TO CONTINUE"
360 IF PEEK(14400) AND 1 THEN 50 ELSE 360
370 CLS:PRINT@21,"**** MOUSETRAP ****":PRINT
380 PRINT"The object of the game is to trap the
    bouncing dot in the top left hand corner of the
    screen."
390 PRINT"If the dot hits a white line it wil bounce off it.
    To draw lines use the four keys marked
    ";CHR$(92);CHR$(93);CHR$(94);
400 PRINT"These keys will draw a line in the direction
    indicated on the keytops.
410 PRINT "If the dot cannot move the game will end
    and you will receive a penalty of 2000 points."
420 PRINT "To erase a line or move without drawing a
    line hold down the space bar & at the same time
    press the appropriate arrow key."
430 PRINT "The stationary dot which appears in a
    random place on the screen at the start of play
    indicates the starting position of your line."
440 PRINT@980,"PRESS ENTER TO PLAY";
450 IF PEEK(14400) AND 1 THEN RETURN ELSE 450
```

M.R. Hall

ANALOGUE CONVERTER

A truly general purpose analogue converter complete with software, to help you make a bit of progress with your measurements.

One of the main functions of the microcomputer is to process data. This data is usually entered into the computer through the keyboard. It would be much more convenient if the computer could gather data for itself, but in general this is not possible because we live in a world of continously variable (analogue) information which is not compatible with the digital workings of a computer.

The function of an Analogue to Digital converter is to turn analogue signals into a digital form acceptable to the computer. It is an electronic interface that is connected between the computer and the signal to be measured. When connected, the computer can take on a new role as a data gathering, data recording and data displaying instrument.

There are several ways of approaching the A/D conversion problem. The simplest consists of using the analogue signal to control the frequency of an oscillator. A software routine can then be used to measure the number of oscillations in a fixed time interval and to relate this to the magnitude of the applied signal. This type of converter has the advantage of low cost, but it is difficult to calibrate and limited in range. At the other extreme are high speed, high cost eight bit parallel A/D converter chips. Apart from their expense, these chips are relatively difficult to obtain and provide a discrimination of only 256 levels.

The unit described in this article provides a good compromise, being inexpensive (less than £15 for the components), reasonably fast (readings are updated at ¼ S intervals) and providing good discrimination (1999 levels). It also has the advantages of automatic zero and self calibration for inputs of -1 V to +1 V.

The Heart Of The Matter

The LD130 chip at the heart of this project was designed for use in digital multimeters. In normal use it accepts input potentials from -999 mV to +999 mV producing a three digit binary coded decimal (BCD) output. The chip features auto zero and the output is directly in millivolts so that no calibration is required except for an initial adjustment.

The external connections to the LD130 are shown in Fig. 1. The capacitor between pin 14 and ground is a timing capacitor for the internal clock. The capacitor between pins 16 and 18 is used by the auto zero function while that between pins 4 and 18 is used as an integrator in the voltage comparator circuit. The accuracy of the output depends on the reference voltage applied to pin 2. The reference voltage should be 2 V.

The output from the IC appears on pins 7 to 13 and pin 5. Typical waveforms that appear on these pins are shown in Fig. 2. The waveforms shown are for an input of +296 mV.

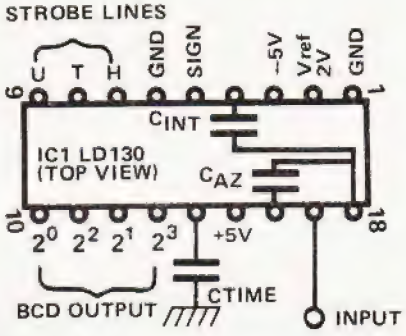


Fig.1. Pin details of the LD130.

Pins 9, 8 and 7 are termed strobe lines, they switch to logic 1 in sequence to indicate which digit of the output (units, tens or hundreds) is being given by the data lines. The BCD outputs corresponding to each digit appear on the data lines — pins 10 to 13 — in binary form. Each digit can, of course, be 0 to 9. The possible combinations are shown in Fig. 3. The values on the data lines switch in time with the strobe lines so that the value of each digit is presented in sequence. The strobe pulses are of shorter duration than the BCD data pulses to ensure that the data levels have finished switching before the data is read.

The output at pin 5 indicates the sign of the input. For a negative input, pin 5 remains at ground potential. For a positive input, pin 5 switches on in time with the 'hundreds' strobe line (pin 7).

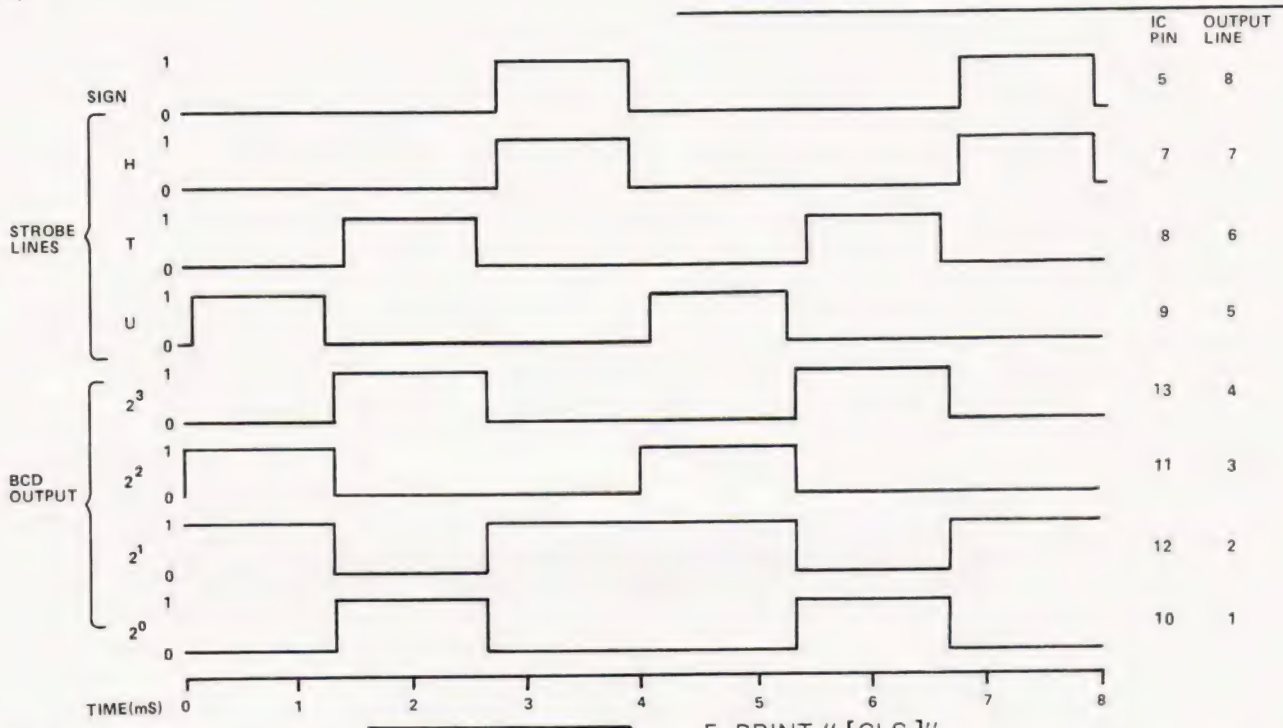


Fig.2. Typical output waveforms produced by the converter IC.

VALUE	PIN NUMBER 13	11	12	10
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1

Fig.3. How the data is encoded in BCD format.

Software

A software routine is required to read and interpret the output from the LD130. The original device was constructed for use with a PET microcomputer and the whole program for use with this is shown in Program A. It should be fairly easy to translate this for use with other micros with the aid of the following description.

The first part of the program is in machine code and its function is to read the output lines from the converter. In the PET this part of the program is POKEd into the second cassette buffer (starting at byte 826, $033A) which is a 'safe' memory location. The output lines from the converter are connected to the VIA lines (user port) of the computer. The computer can then read these lines in such a way that their on/off status can be considered as the bits of an 8 bit binary number. For example at a particular instant lines 7,3 and 2 could be 'on' while the other 5 lines are 'off'. The computer would then read the user port value as binary 01000110 (70 decimal, 46Hex). The program requires that the status of individual lines should be tested, or that the value on a group of lines is read. This is achieved by a technique known as masking. In this technique the user port value is ANDed with another binary number (the mask). The bits of each number will then be compared, returning '1' only when both of the compared bits are '1'. In the above example to test if line 7 is 'on' it must be ANDed with decimal 64.

70_{10}	01000110	46H
64_{10}	01000000	40H
68_{10} AND $64_{10} = 64_{10}$	01000000	46H AND 40H = 40H

The non zero result indicates that bit 7 was 'on'. The absence of a '1' at bit 7 would have resulted in an answer whatever the status of the other lines.

```
 5 PRINT " [CLS ]"
10 DATA 169, 0, 141, 67, 232, 173, 79, 232, 41, 16,
   240, 249, 160, 3, 32, 113, 3, 173
20 DATA 79, 232, 41, 32, 240, 249, 160, 2, 32, 113,
   3, 173, 79, 232, 41, 64, 240, 249, 160
30 DATA 1, 32, 113, 3, 162, 64, 202, 208, 256, 173,
   79, 232, 41, 128, 141, 232, 3, 96
40 DATA 173, 79, 232, 41, 15, 153, 232, 3, 96
50 FOR I=1 TO 64:READ A:POKE(825+I),A:NEXT
60 SYS 826:A=0
70 FOR I=1 TO 3:A=A+PEEK(1000+I)*10↑(3-I):
   NEXT
80 A=A*SGN(PEEK(1000)-1)
90 PRINT " [HOM ] [6 CD ] [4 SPC ]";A;
   " [CL ] [5 SPC ]"
100 GOTO 60
```

BASIC program to use the converter

By a similar process the value being carried by the first four (data) lines can be obtained. In this case the user port value is masked with decimal 15.

70_{10}	01000110	46H
15_{10}	00001111	0FH
70_{10} AND $15_{10} = 6_{10}$	00000110	46H AND 0FH = 06H

```
033A  A9 00       LDA # 00        ] Make all
                                  ] VIA input lines
033C  8D 43 E8    STA $E843       ] input
033F  AD 4F E8  ULI:LDA $E84F     ] Wait until
0342  29 10       AND # 10        ] 'unit' strobe
0344  F0 F9       BEQ ULI         ] line is
0346  A0 03       LDY # 03        ] on
0348  20 71 03    JSR $0371
034B  AD 4F E8  TLI:LDA $E84F     ] Wait until
034E  29 20       AND # 20        ] 'ten' strobe
0350  F0 F9       BEQ TLI         ] line is
0352  A0 02       LDY # 02        ] on
0354  20 71 03    JSR $0371
0357  AD 4F E8  HLI:LDA $E84F     ] Wait until
035A  29 40       AND # 40        ] 'hundred' strobe
035C  F0 F9       BEQ HLI         ] line is
035E  A0 01       LDY # 01        ] on
0360  20 71 03    JSR $0371
0363  A2 40       LDX # 40        ]
0365  CA        DEL:DEX          ] Delay
0366  D0 FD       BNE DEL         ]
0368  AD 4F E8    LDA $E84F       ] Read and
036B  29 80       AND # 80        ] store sign
036D  8D E8 03    STA $03E8       ]
0370  60          RTS
0371  AD 4F E8    LDA $E84F       ] Read and
0374  29 0F       AND # 0F        ] store
0376  99 E8 03    STA $03E8,Y     ] BCD data
0379  60          RTS
```

Assembler listing of the read program.

```
033A  A9 00 8D 43 E8 AD 4F E8
0342  29 10 F0 F9 A0 03 20 71
034A  03 AD 4F E8 29 20 F0 F9
0352  A0 02 20 71 03 AD 4F E8
035A  29 40 F0 F9 A0 01 20 71
0362  03 A2 40 CA D0 FD AD 4F
036A  E8 29 80 8D E8 03 60 AD
0372  4F E8 29 0F 99 E8 03 60
037A  00 FF 00 FF 00 FF 00 FF
```

Hex dump of the Assembler listing.

Thus the result of decimal 6 is obtained for the value being carried by the data lines.

The machine code part of the program is shown both in assembler and Hex form in Program B for the 6502. In essence the program waits for each strobe line to come 'on'. When a line is 'on', it reads the data lines and stores their value. When the three digits have been read and stored, the sign is read after a delay to ensure complete switching. The sign value from line eight is stored as 0 for a negative input, 128 for a positive input. The sign value is stored in location 1000 ($03E8) and digit values (hundreds, tens and units of millivolts) are stored in locations 1001 to 1003.

The final part of the program is in BASIC. It reads the values contained in the bytes listed above and converts them into the variable 'A' which can then be displayed, processed or stored as required.

Construction

A complete circuit for the converter and power supply is shown in Figs 4 & 5. A suggested component layout is shown in Figs 6 & 7. The prototype was built on two pieces of veroboard but the layout is not critical and could easily be changed to suit individual requirements. No details are given for switches, sockets etc.

The power supply board carries few components and is easy to construct. The transformer should be mounted on the board first by enlarging a couple of holes in appropriate positions, then using 6BA nuts and bolts to secure it. The conducting strips around the bolts should be cut to prevent short circuits. When mounting the diodes and smoothing capacitors take care that they are connected the right way round. Note also that the voltage regulators have different pin notations.

On the main converter board, the components should be soldered in place as shown. The IC could be soldered directly into position, but it is strongly recommended that an IC socket is used to minimise the risk of damage. The output from the converter board to the computer is best taken out through a length

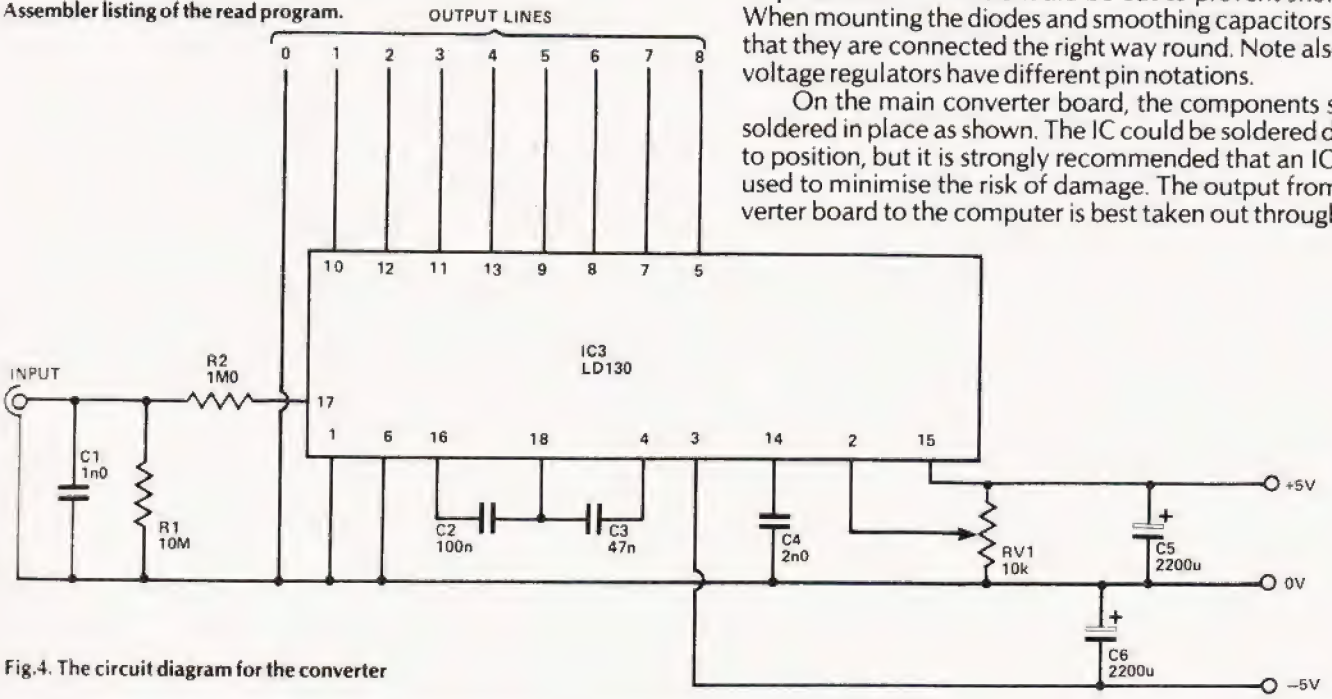


Fig.4. The circuit diagram for the converter

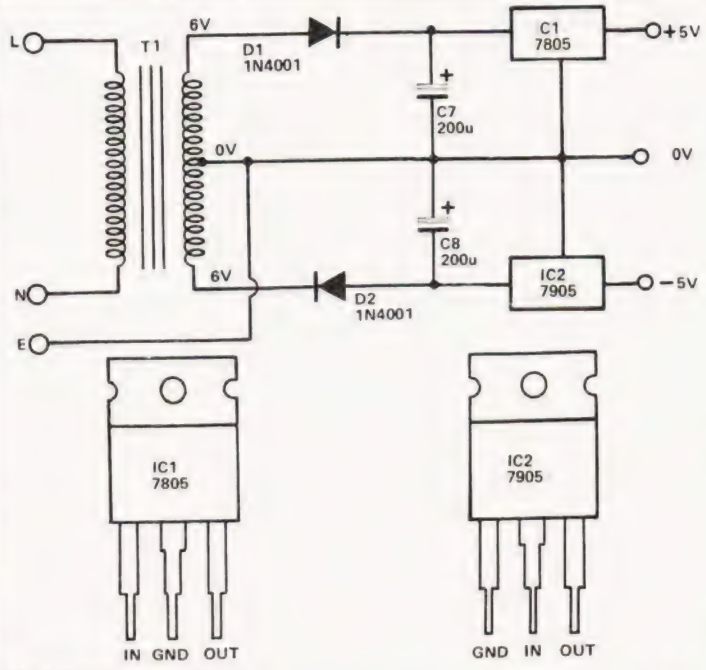


Fig.5. Power supply circuit.

of ribbon cable. If a PET is being used, the cable should be connected to an edge connector as shown in Fig. 8. When the soldering is complete, the IC can be pushed into its holder, but make sure it is the right way round.

When all construction is complete, check that there are no solder bridges between adjacent tracks and that the tracks have been cut in the correct places.

Setting Up

When the construction is complete and the program written and recorded, the convertor should be plugged into the VIA input of the computer. In the case of a PET the edge connector should be connected to the middle port at the rear of the machine with the connecting wires at the bottom. Do not yet apply mains to the converter. The program should be LOADed and RUN — a display of 1665 or -1665 should be obtained. If the program crashes, reload it and check that the values in the data

PARTS LIST

Resistors all ¼ W 5%	
R1	10M
R2	1M0
RV1	10k horizontal preset
Capacitors	
C1	1n0 polystyrene
C2	100n Mylar
C3	47n Mylar
C4	2n0 polystyrene
C5,6,7,8	2200u 20V Electrolytic
Semiconductors	
D1,2	1N4001 diode
IC1	7805 voltage regulator +5V
IC2	7905 voltage regulator −5V
IC3	LD130

Miscellaneous

T1 6-0-6V 100mA miniature mains transformer, Ribbon cable, 12/24 edge connector socket 0.156" (for PET connection).

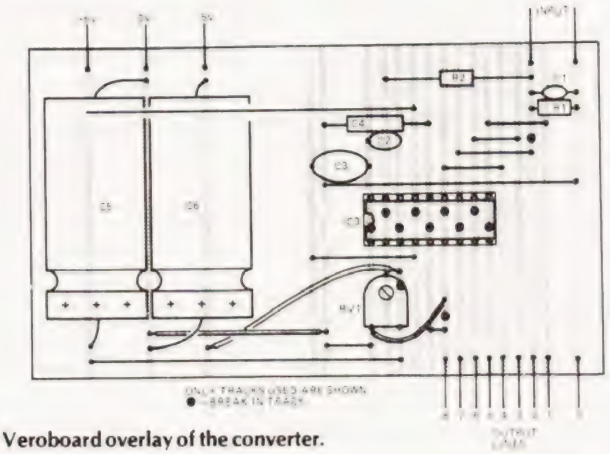


Fig.6. Veroboard overlay of the converter.

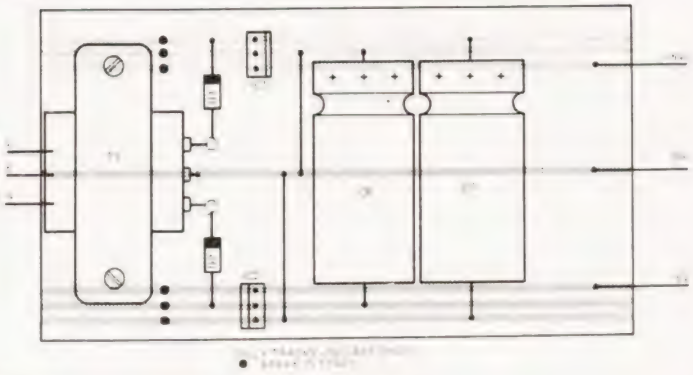


Fig.7. Veroboard overlay for the power supply.

statements are correct. The converter should now be connected to the mains and the display should quickly change to 0 with occasional excursions to 1 or -1.

A voltmeter should then be connected between pin 2 and the 0 V power line, then, by turning the slider on RV1, the voltage on pin 2 should be adjusted until it is as near as possible to 2 V.

The unit is now ready for use and can be tested by connecting a variable voltage supply to the input. As the voltage is changed, the display should settle to the new potential within about a second. If an illogical sequence of numbers is displayed, it is probable that the data lines have been connected in the wrong order.

If excessive potentials are applied to the input, the display will eventually lock at a meaningless value until the potential is removed. Grossly excessive inputs will, of course, burn out the IC.

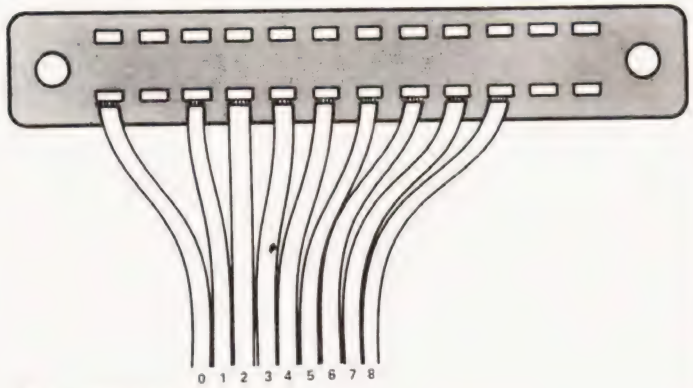


Fig.8. Connector wiring for PET.

ANALOGUE CONVERTER

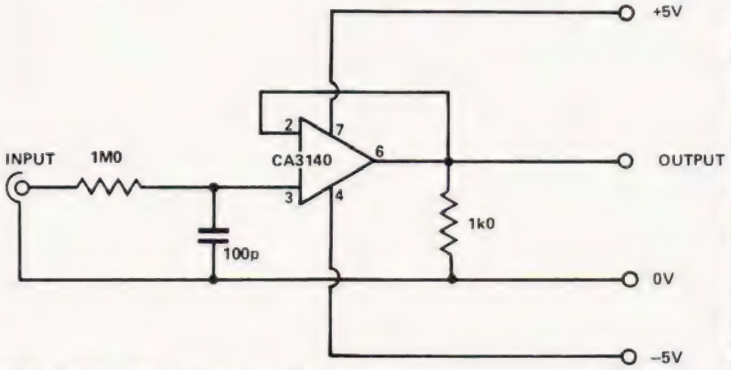
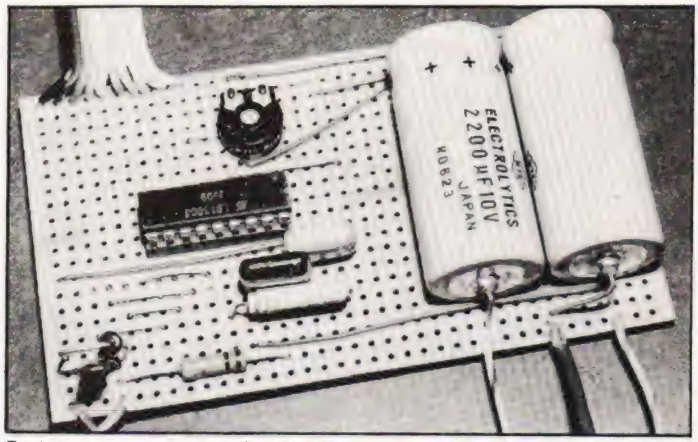


Fig.9. Suggested high impedance buffer.



Prototype converter unit showing the component orientation.

Applications

The applications of this unit are almost innumerable. When it is connected to a microcomputer, the combination becomes a universal measuring display and recording device. Just about anything capable of producing an electrical signal can be interfaced to the converter. The output from the converter can be read and processed by the computer in a variety of ways. For example:-

- digital display on screen
- output to printer
- store readings in an array for later processing
- graphical presentation

The converter does not use the interrupt line so this is still available as a trigger line for data recording.

The input impedance of the device is 10 M which is quite high enough for most applications, but there are occasions, such as in the use of a pH electrode, when even higher impedances are required. In this case a CMOS op amp, such as the CA3140, can be used as an impedance converter (see Fig 9). The input impedance of this device is about 1 T0 (10^{12} R) which is so high that care must be taken when using this device not to leave the input disconnected, since it can be destroyed by static discharges.

By using suitable transducers, potential dividers, operational amplifiers and electrode systems, it is possible to measure quantities such as voltage, current, resistance, light, sound temperature, pH, electrode potential and oxygen concentration.

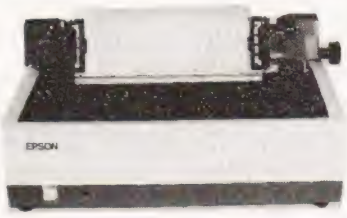
enter the computer age
video genie system

- 12K MICROSOFT BASIC
- 16K RAM, UHF MODULATOR
- INTERNAL CASSETTE
- SECOND CASSETTE INTERFACE

£330 + VAT

- 80 COLUMNS
- 70 LINES PER MINUTE
- GRAPHICS CHARACTERS
- INTERFACES TO MOST MACHINES

£395 + VAT



- 100's OF PROGRAMS AVAILABLE
- TRS-80 LEVEL II SOFTWARE COMPATIBLE

CATRONICS LTD.
20, Wallington Square, Wallington, Surrey
Telephone: 01-669 6700/6701

UNIVERSITY OF LIVERPOOL MICROPROCESSOR LABORATORY

Microcomputer Assembler Programming

5 Afternoons, Starting Tuesday 11th November 1980

This course gives a practical introduction to assembler level programming of Micro-computer systems, particularly those based on the extremely popular 6502 processor. Each afternoon is split into a lecture covering the basic principles of programming in assembler, followed by an extended practical, arranged around the AIM – 65 single-board computer. The principles discussed can be applied with equal ease to the APPLE and the PET Micro-computers, which are also based on the 6502.

For prices and further information, please contact:

Dr. Martin Beer,
Computer Laboratory,
University of Liverpool,
P.O. Box 147,
LIVERPOOL
L69 3BX

Telephone 051-709-6022 Ext. 2967

CHROMASONIC electronics

56 FORTIS GREEN ROAD
MUSWELL HILL LONDON
N10 3HN

TELEPHONE 01-883 3705, 01-883 2289

your soundest connection in the world of components

NEW PARALLEL INTERFACE Built & Tested £29.95

NEW LOW PRICE

PETS

All with new keyboard and green screen

8N 8K RAM	**£399**
16N 16K RAM	**£499**
32N 32K RAM	**£599**
CASSETTE DECK	**£55**

INTERFACES AVAILABLE

X-Y Plotters, Analogue to Digital Convertors, 16 Channel Interfaces, B1 Directional Interfaces, etc.

UK 101

THE FASTEST GROWING FOLLOWING KIT **£179** OF THEM ALL

- *Free sampler tape.
- *8K Basic in ROM
- *4K RAM expandable to 8K on board.
- *Kansas City tape interface.
- *RS232 Interface.
- *Full QWERTY keyboard

NEW MONITOR CHIP ALLOWS FULL CURSOR CONTROL AND EDITING £22

8 x 2114 £22.50

BUILT & TESTED £229

LS Series

74LS00	.18	74LS33	.26	74LS93	.60	74LS155	.72	74LS192	1.04	74LS273	1.70
74LS01	.18	74LS37	.23	74LS95	.81	74LS156	.72	74LS193	1.04	74LS279	.57
74LS02	.18	74LS38	.23	74LS96	1.16	74LS157	.57	74LS194	.86	74LS283	1.09
74LS03	.19	74LS40	.20	74LS107	.32	74LS158	.57	74LS195	.97	74LS289	4.50
74LS04	.20	74LS42	.65	74LS109	.32	74LS160	1.09	74LS196	.97	74LS290	.91
74LS05	.22	74LS47	.81	74LS112	.32	74LS161	.69	74LS197	.97	74LS293	.91
74LS08	.20	74LS48	.81	74LS113	.32	74LS162	1.16	74LS221	.92	74LS295	1.30
74LS09	.22	74LS49	.81	74LS114	.32	74LS163	.69	74LS240	2.08	74LS296	1.16
74LS10	.20	74LS51	.18	74LS122	.69	74LS164	1.06	74LS241	2.08	74LS348	
74LS11	.20	74LS54	.18	74LS123	.72	74LS165	.72	74LS242	2.08	74LS352	1.04
74LS12	.20	74LS55	.18	74LS124	1.39	74LS166	1.65	74LS243	2.08	74LS353	.92
74LS13	.37	74LS73	.33	74LS125	.36	74LS168	1.71	74LS245	2.50	74LS362	4.21
74LS14	.65	74LS74	.30	74LS126	.36	74LS169	1.71	74LS247	1.09	74LS365	.55
74LS15	.20	74LS75	.40	74LS132	.60	74LS170	1.72	74LS248	1.09	74LS366	.55
74LS20	.20	74LS76	.27	74LS133	.39	74LS173	.81	74LS249	1.09	74LS367	.55
74LS21	.20	74LS78	.27	74LS136	.36	74LS174	.97	74LS251	.96	74LS368	.55
74LS22	.20	74LS83	.78	74LS138	.65	74LS175	.97	74LS253	.92	74LS373	.78
74LS26	.20	74LS85	.81	74LS139	.65	74LS181	2.77	74LS257	.92	74LS386	.36
74LS27	.20	74LS86	.27	74LS145	.97	74LS188	2.75	74LS258	.92	74LS393	.84
74LS28	.22	74LS90	.57	74LS151	.81	74LS189	2.08	74LS259	1.39	74LS668	1.17
74LS30	.20	74LS91	.97	74LS153	.52	74LS190	.86	74LS261	4.50	74LS670	1.71
74LS32	.26	74LS92	.69	74LS154	1.30	74LS191	.86	74LS266	.37		

PRINTERS

EPSON TX-80

£375

Dot-matrix printer with Pet graphics Interface: Centronics parallel, options: PET, Apple and serial.

Phone or send s.a.e. for latest price list on all our range.
Please add VAT 15% to all prices. Postage on computers, printers, and cassette decks charged at cost, all other items P.&P. 30p.
Place your order using your Barclay or Access Card. (Minimum Telephone order £5.00). Trade and Export enquiries welcome.
Credit Facilities arranged.

D.J. Stephenson

RESULTS PLOTTER

A utility program to give you neat and tidy graphical output - show you mean business with this excellent routine.

Many programs already exist which take advantage of the high resolution graphics capability of the ITT 2020 and APPLE series of microcomputers. Those which produce a graph plot of a mathematical function usually split the x and y axes into n equal parts and display the value which each scale division represents. This procedure invariably results in an ugly string of mixed digits spreading half way across the screen, requiring tedious mental approximations before points on the curve can be evaluated.

Solving The Problem

The problem is overcome in this program by positioning the axis divisions according to a straightforward power of ten rule. For example, if the x axis limits for a particular equation are entered as −50 and +50, the program will accurately place five division 'pips' in each direction from the zero intercept and produce a text output:-

X AXIS * 10

The Y axis is processed in a similar manner. If the x axis limits are entered as −30 and +63 (or similar unruly figures) the division 'pips' are still presented in simple powers of ten.

Existing programs appear to use the DEF FN statements for placing the equations into specific line numbers. Thus to plot the graphs of X squared and X cubed on the same axes it is necessary to type out,

```
DEF FNF (X) = X^2
DEF FNG(X) = X^3
```

This method was found tedious and it was decided to ditch it in favour of a subroutine. This allows a simpler and less error-prone entry as follows,

```
Y = X^2
Z = X^3
```

There appears to be no appreciable difference in execution time as a result.

A further advantage is that either one or two functions can be plotted at each RUN without the dreaded "UNDEF'D FUNCTION ERROR" polluting the screen and halting execution. An error-handling subroutine is provided to deal with division-by-zero errors which can occur when attempting to plot curves of the 1/X or TAN(X) forms. Apart from this, the program includes the usual mundane features such as auto scaling and computing the Y axis limits. Two equations can be processed simultaneously by finding the highest and lowest Y co-ordinates of *both* equations and then setting Y axis limits accordingly.

Using The Program

The program is written in "PALSOFT" BASIC for the ITT 2020 but should also run on an APPLE II (APPLESOFT) providing line 102 is amended to,

```
102 W = 279 : H = 159
```

(This is necessary to compensate for the reduced resolution of the APPLE)

The display invites you to enter the equations in line numbers 3000 and/or 4000 according to the following example format,

```
3000 Y = SIN (X)
4000 Z = COS (X)
```

For convenience, CONSTANTS can be defined in line 104, using any spare variables. You will be asked for X axis limits but it is unimportant in which order these are entered because they are automatically arranged correctly by the program. The number of plotting points (the plotting density) can be chosen within the range 100 — 300 per graph although it will be appreciated that execution time increases with plotting density.

It may also be obvious that the auto Y axis-limits feature must be overidden for graphs with inherent discontinuities such as 1/X and TAN(X). Graphs with offset origins can be plotted in any quadrant since the relevent values X max, X min, Y max, Y min are always displayed.

For those who are interested, the particular equations shown in the listing plots a simple sine wave and superimposed, a second curve portraying the fundamental, third and fifth harmonic. This shows how a "square wave" can be built up by addition of the odd harmonics according to the Fourier series. The program will run in a 16K machine providing the REM statements are omitted. It is wise to set HIMEM to 8192. However, if the REM statements are typed in, the program will overspill into the high resolution graphics page one of memory. If the machine is 32K or over, set LOWMEM: 16384 to avoid this problem.

Breakdown

The program breakdown is shown in the following table:

LINE NUMBERS	REMARKS
10 — 60	Instructions for use, enter equations
102	Set max HPLOT co-ordinates (depending on machine)
110 — 125	Input and order x axis limits
130 — 145	Input options, find plotting increment
147 — 160	Initialise Y axis limit (auto mode)
165 — 185	Input and order y axis limits (manual mode)
197 — 260	Fill arrays with y and z values and process y axis limits (auto mode)
267 — 270	Set graphics and text mode
277 — 300	Find origin and draw axes
307 — 360	Find and draw axes division
367 — 370	Label axes
377 — 410	Label axes for offset origin
417 — 420	Plot 1st graph
427 — 430	Plot 2nd graph
437 — 450	Press any key to continue routine
510 — 570	Input option
997 — 1070	Scaling subroutine
1997 — 5000	Equations subroutine
6997 — 7040	Division of axes subroutine
7997 — 8040	Division by zero error-handling subroutine

```
 10 TEXT:HOME:PRINT TAB(14) "GRAPH PLOT":
    PRINT:PRINT
 20 PRINT "PROVISION OF Y AXIS LIMIT IS
    MANDATORY"
 25 PRINT "FOR NON-CONTINUOUS GRAPHS
    ONLY"
 30 PRINT:PRINT "ENTER EQUATIONS IN LINES
    3000 AND/OR"
 35 PRINT "4000 IN THE FORM: -":PRINT
 40 PRINT "3000 Y=FUNCTION(X)":PRINT
 45 PRINT "4000 Z=FUNCTION(X)":PRINT
 50 PRINT "ENTER EQUATIONS THEN TYPE 'RUN
    100'
 55 PRINT
 60 END
 97 REM ** START OF PROGRAM PROPER
100 DIM Y(301),Z(301),A$(1)
101 REM ** SET MAX HI-RES PLOT CO-
    ORDINATES
102 W=359:H=159
105 HOME:INPUT "LABEL X AXIS LIMIT (1) ";A:
    PRINT
110 INPUT "LABEL X AXIS LIMIT (2) ";B:PRINT
115 IF A<B THEN XL=A:XR=B:GOTO 130
120 IF A>B THEN XL=B:XR=A:GOTO 130
125 GOTO 105
130 INPUT "ENTER PLOTTING DENSITY (1-3) ";A:
    PRINT
135 IF A>3 OR A<1 THEN 130
137 REM ** FIND PLOTTING INCREMENT
140 K=A*100:INC=(XR-XL)/K
145 INPUT "Y AXIS LIMITING (Y/N) ? ";A$:PRINT:
    PRINT
147 REM ** INITIALISE Y AXIS LIMITS VIA LAST
    X,Y
150 IF A$="N" THEN X=XR:GOSUB 2000:YT=Y:
    YB=Y:GOTO 190
155 IF A$="Y" THEN 165
160 GOTO 145
165 INPUT "LABEL Y AXIS LIMIT (1) ";A:PRINT
170 INPUT "LABEL Y AXIS LIMIT (2) ";B
175 IF A<B THEN YB=A:YT=B:GOTO 190
180 IF A>B THEN YB=B:YT=A:GOTO 190
185 GOTO 165
190 HOME:VTAB 21:HTAB 8:PRINT "TABULATION
    IS PROCEEDING"
197 REM ** FIND Y AND Z VALUES PLUS Y AXIS
    LIMITS
200 N=0:FOR X=XL TO XR STEP INC:N=N+1:
    GOSUB 2000:Y(N)=Y:Z(N)=Z:IF A$="Y" THEN
    NEXT:GOTO 260
210 IF YT<Y THEN YT=Y
220 IF YB>Y THEN YB=Y
230 IF YT<Z THEN YT=Z
240 IF YB>Z THEN YB=Z
250 NEXT
260 XX=(XR-XL):YY=(YT-YB)
267 REM ** SET GRAPHICS AND TEXT MODE
270 HGR:HCOLOR=3:POKE 34,20:CALL -936
277 REM ** FIND ORIGIN AND DRAW AXES
280 X=0:Y=0:GOSUB 1000:Y1=(Y2-5):X1=
    (X2+5):HPLOT X2,0 TO X2,H:HPLOT 0,Y2 TO
    W,Y2
290 IF Y1<10 THEN Y1=(Y2+5)
300 IF X1>W-10 THEN X1=(X2-5)
307 REM ** FIND AND DRAW SCALE AXES
    DIVISIONS
310 IF ABS(XL)>=ABS(XR) THEN B=XL:GOSUB
    7000:P=B*10↑E:Q=XR:R=10↑E:GOTO 330
320 B+XR:GOSUB 7000:P=B*10↑E:Q=XL:R=
    -1*10↑E
330 FOR X=P TO Q STEP R:GOSUB 1000:HPLOT
    X2,Y2 TO X2,Y1:NEXT
340 IF ABS(YT)>=ABS(YB) THEN B=YT:GOSUB
    7000:P=B*10↑E:Q=YB:S=-1*10↑E:GOTO
    360
350 B=YB:GOSUB 7000:P=B*10↑E:Q=YT:S=
    10↑E
360 X=0:FOR Y=P TO Q STEP S:GOSUB 1000:
    HPLOT X2,Y2 TO X1,Y2:NEXT
367 REM ** LABEL AXES
370 CALL -936:PRINT:PRINT "X AXIS *" ABS(R)
    TAB(21)"Y AXIS * "ABS(S)
377 REM ** LABEL AXES FOR AN OFFSET ORIGIN
```

RESULTS PLOTTER

```
380 IF YB>0 THEN VTAB 23:PRINT TAB(21)"Y
    (MIN)= "YB
390 IF YT<0 THEN VTAB 23:PRINT TAB(21)"Y
    (MAX)= "YT
400 IF XL>0 THEN VTAB 23:PRINT "X (MIN)= "XL
410 IF XR<0 THEN VTAB 23:PRINT "X (MAX) ="XR
417 REM ** PLOT FIRST GRAPH
420 N=0:FOR X=XL TO XR STEP INC:N=N+1:
    Y=Y(N):GOSUB 1000:HPLOT X2,Y2:NEXT
427 REM ** PLOT SECOND GRAPH
430 N=0:FOR X=XL TO XR STEP INC:N=N+1:Y=
    Z(N):GOSUB 1000:HPLOT X2,Y2:NEXT
437. REM ** ANY KEY TO CONTINUE
440 X=PEEK(-16384):IF X<127
    THEN 440
450 POKE -16368,0:TEXT:HOME
510 VTAB 10:PRINT "THE FOLLOWING OPTIONS
    ARE AVAILABLE:-":PRINT
520 PRINT "(1) RE-PLOT (SAME AXES)"
530 PRINT "(2) REPEAT (DIFFERENT AXES)"
540 PRINT "(3) ENTER NEW EQUATIONS"
550 PRINT "(4) END PROGRAM"
560 PRINT:PRINT:INPUT "ENTER OPTION ";A:IF
    A>4 OR A<1 THEN 560
570 ON A GOTO 270,105,10,580
580 HOME:END
997 REM ** SCALING SUBROUTINE
1000 X2=INT(W*(X-XL)/XX)
1010 IF Y<YB OR Y>YT THEN Y=0
1020 Y2=INT(H*(YT-Y)/YY)
1030 IF Y2<0 THEN Y2=0
1040 IF X2<0 THEN X2=0
1050 IF Y2>H THEN Y2=H
1060 IF X2>W THEN X2=W
1070 RETURN
1997 REM ** EQUATIONS SUBROUTINE
2000 ONERR GOTO 8000
3000 Y=SIN(X)
4000 Z=SIN(X)+(1/3*SIN(3*X))+(1/5*SIN(5*X))
5000 RETURN
6997 REM ** DIVISION OF AXES SUBROUTINE
7000 E=0:BB=B:B=ABS(B)
7010 IF B>=10 THEN B=B/10:E=E+1:GOTO 7010
7020 IF B>=1 AND B<10 THEN B=INT(B):IF BB<0
    THEN B=-B:GOTO 7040
7030 IF B<1 THEN B=B*10:E=E-1:GOTO 7010
7040 RETURN
7997 REM ** DIVISION BY ZERO ERROR
    SUBROUTINE
8000 A=PEEK(202):POKE 216,0
8010 IF A=133 THEN 8030
8020 RESUME
8030 IF X=XR THEN XR=XR+INC/10:GOTO 150
8040 VTAB 23:PRINT "TRYING TO RECTIFY
    DIVISION BY ZERO ERROR":XL=XL-INC/10:
    GOTO 200
```

£395
incl.VAT& P&P

micron

'MICRON' may sound small - but we all know that it's much larger than an atom!

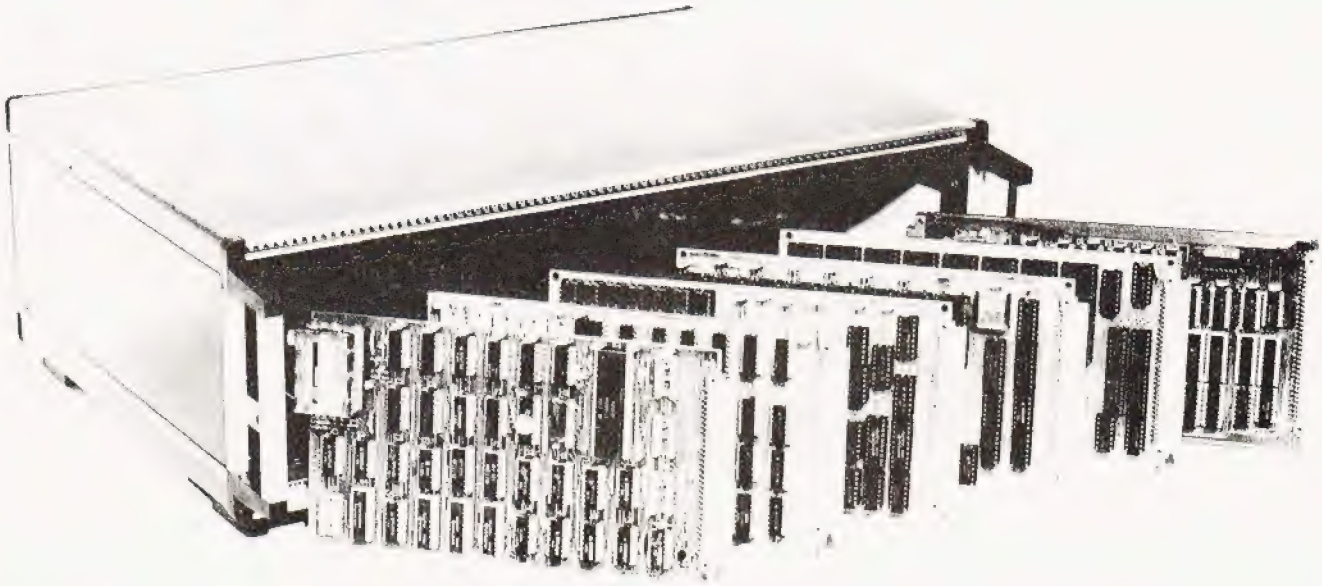
The un-beatable features of Microtan 65 and Tanex have been brought together to give you **Micron**, a ready built and tested computer of outstanding value. Fully supported by comprehensive documentation, **Micron** represents an ideal starting point in personal computing. We've taken a full O.E.M. licence for Microsoft Basic, which means that you'll have the support of the most popular Basic available, (as used on PET, APPLE, TANDY etc.). If you want to expand **Micron** there's no problem, just move into the system rack and choose from the range of Microtan modules. Read the information, study what the magazines have to say about us and compare what we have to offer with other systems, then we feel sure that you'll be convinced that we've produced an excellent product.

FULLY BUILT, TESTED AND CASED.
6502 BASED MICROCOMPUTER.
VDU ALPHA NUMERIC DISPLAY.
8K RAM.
32 PARALLEL I/O LINES.
2 TTL SERIAL I/O LINES.
1 SERIAL I/O PORT WITH RS232/20mA LOOP, AND 16 PROGRAMMABLE BAUD RATES.
300 / 2400 BAUD FILENAMED CASS. INTERFACE.
DATA BUS BUFFERING.
MEMORY MAPPING CONTROL.
71 KEY ASCII KEYBOARD, INCLUDING NUMERIC KEYPAD.
POWER SUPPLY INCLUDED.

SOFTWARE
10K EXTENDED MICROSOFT BASIC.
ALL THE USUAL BASIC COMMANDS.
INTEGER AND REAL NUMBERS.
INTEGER AND REAL ARRAYS.
INTRINSIC FUNCTIONS: ABS, INT, RND SGN, SIN, SQR, TAB, USR, ATN, COS, EXP, LOG, TAN.
USER DEFINED FUNCTIONS.
READ AND DATA STATEMENTS.
DUMP AND LOAD PROGRAMS.
PROGRAM EDITING COMMAND.
STRING FUNCTION FOR TEXT I/O.
BASIC CAN CALL MACHINE CODE SUB-ROUTINE.
USER MACHINE CODE INTERRUPT HAND-LER INTERFACES WITH BASIC.
XBUG.
DATA CASSETTE FILE HANDLING IN BASIC

COMPUTER SYSTEMS LIMITED
Forehill Works
Forehill Ely Cambs England **Tel: (0353)3633**

microtan 65



The **Microtan** system is rapidly becoming accepted as the ultimate approach to personal computing. Start with **Microtan 65**, a 6502 based single board computer, and expand to a powerful system in simple and in-expensive stages. The **Microtan** system is a concept and not an afterthought, this means expansion is easy and very efficient! Unlike many other systems, you'll find it difficult to outgrow **Microtan**, and you won't be wasting your money on a product that will only last you a few months! When you are ready to expand, **Tanex** is waiting. The features offered by Tanex are tremendous, and you can start into them for just £49.45! Cassette interface, 16 I/O lines, two 16 bit counter timers, data bus buffering, memory mapping and a further 1K of RAM are standard. From thereon expansion is simple, just plug in extra integrated circuits to get yourself 8K of RAM, a further 16 I/O lines and two more counter timers a serial I/O line with RS232/20mA loop and full modem control, XBUG - a firmware package containing cassette file handling routines, plus a line-by-line assembler (translator) and dis-assembler, PLUS 10K EXTENDED MICROSOFT BASIC, a suped-up version of the Basic as used by major manufacturers such as Apple, Tandy and Nascom, NO OTHER LOW COST MICROCOMPUTER OFFERS YOU THIS SUPERB PACKAGE. O.K. so you want more memory, try **Tanram** for size! Upto 40K bytes on one board starting for as little as £50.60. RAM freaks will be pleased to hear that our system mother board offers page memory logic which will support 277K Bytes, satisfied? To house these beautiful modules you can choose between our mini-rack (as used on **Micron**), which accepts **Microtan** and **Tanex**, or our system rack pictured above. The system rack will support 12 modules. What are these extra modules? Well for starters there's a couple of I/O modules, parallel and serial offering upto 128 I/O lines organised as 16 8 bit ports and 8 serial I/O ports respectively. Shortly we'll be introducing high definition (256x256) colour graphics, A to D and D to A modules, IEEE 488 Bus interface, a PROM programmer, disc controller and **TANDOS** - a 6502 CPM system. So there's plenty to keep you busy. Send for more details, and find out how you can get started for just £79.35!

ALL PRICES QUOTED INCLUDE V.A.T.

AIM 65, KIM 1, SIM 1 USERS- READ ON!

We have produced a T.V. interface module which simply connects to the expansion socket of your computer and produces a display of 16 rows by 40 characters! Of even more interest will be our Buffer module, which allows you to expand into our system rack, giving you access to the full range of Microtan modules.

Please underline the information required.

AIM T.V. INTERFACE. MICROTAN SYSTEM.

NAME: _____

ADDRESS: _____

_____

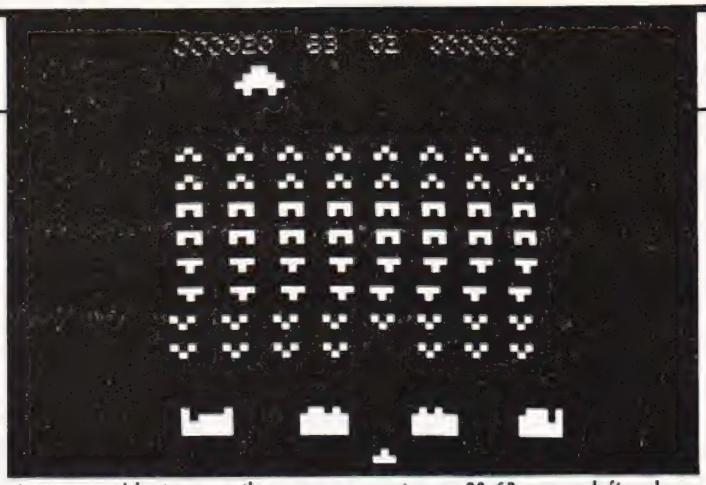
PLEASE ENCLOSE 12p STAMP. THANK YOU.

Software: Mike Rose.
Hardware: Paul Johnson
Development: Steve Ramsahadeo

The 6502 software for this addictive and ever popular micro-game. Available in ROM for MICRON too!

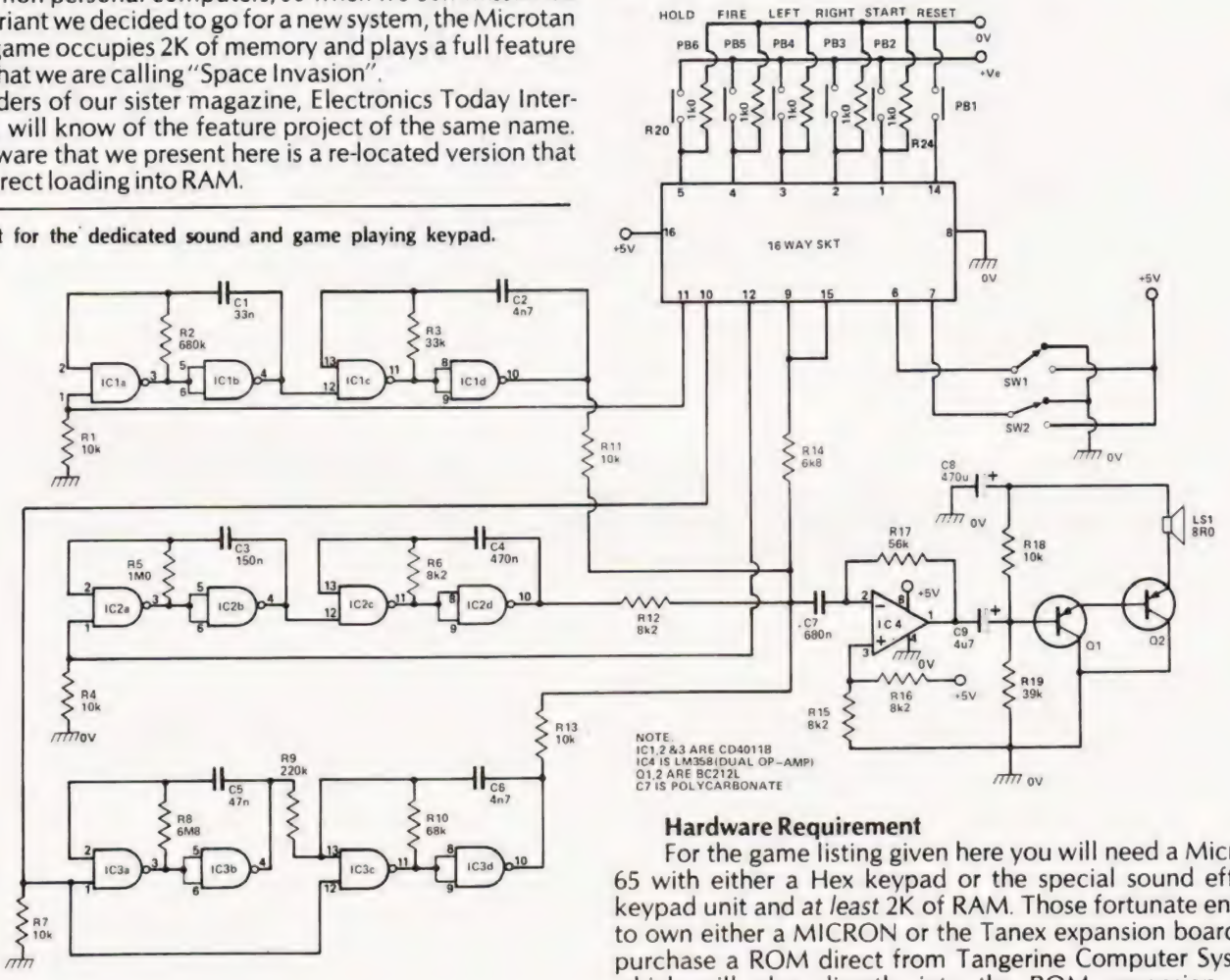
Invaders: a name that immediately conjures up images of queues in pubs and at motorway service stations where devotees spend hours (and small fortunes) blatting away at the massed ranks of weirdly shaped objects on a TV screen. Programs for "Invaders" type games have emerged for most of the common personal computers, so when we commissioned a new variant we decided to go for a new system, the Microtan 65. The game occupies 2K of memory and plays a full feature version that we are calling "Space Invasion".

Readers of our sister magazine, Electronics Today International, will know of the feature project of the same name. The software that we present here is a re-located version that allows direct loading into RAM.



A saucer widgets across the screen, current score 20, 63 saucers left and you only have two spare bases. Can you win?

The circuit for the dedicated sound and game playing keypad.



Game Features

Among the major features of the game are the full screen scoring, the sound effects and the 'game hold' facility, but overall this ranks with the best pub and arcade games. The best way to give you the features is just to list them — so here goes:

Four different sound effects
Extra bases won every 2000 points with a maximum of four live bases at any time.
Four levels of game difficulty
Game hold facility
Full screen scoring
Flying saucer with bonus points
Eight ranks of aliens.

Hardware Requirement

For the game listing given here you will need a Microtan 65 with either a Hex keypad or the special sound effects/keypad unit and *at least* 2K of RAM. Those fortunate enough to own either a MICRON or the Tanex expansion board can purchase a ROM direct from Tangerine Computer Systems which will plug directly into the ROM expansion area. Dedicated fans can then have their favourite game on tap 24 hours a day.

For DIY fans the following information will be of assistance. The game level is set by a binary code on pins 6 and 7 of the keyboard socket, "easy" is both low and "hardest" is both high with the two intermediate levels being logically coded between the two. The operating buttons are connected as follows: Reset-pin 14 to ground, Hold-pin 5 to Vcc, Fire-pin 4 to Vcc, Left-pin 3 to Vcc, Right-pin 2 to Vcc and Start-pin 1 to Vcc. Note that all control inputs except Reset are normally held low through 1k resistors.

The sound outputs are controlled by the following signals: Heartbeat-gated by a logic '1' on pin 12, Flying saucer-gated by a logic '1' on pin 10, Laser-gated by logic '0' on pin 11. All these

sounds must be generated by an external oscillator system. The 'Explosion' sound is generated by the software and appears as a series of pulses on pin 9, the normal state is logic '0'. We have given a suggested circuit but there is nothing to stop you going your own way, except that you must remember not to load any of the signals either coming from or going to the main CPU board.

Those who do not wish to 'splash-out' on building a dedicated sound unit for the game can control the action from their Hex keypads in the following fashion. The movement keys 'Left' and 'Right' are keys 4 and 8 respectively, 'Fire' is key C, 'Play' is key 0, 'Hold' is key shift and 'Reset' is Reset. This layout was chosen to simplify use of the controls by just turning the keypad on its side. The difficulty factor can be 'rigged' by soldering links onto the underside of the keypad output socket.

Software Notes

Because of the sheer size of the program we have presented it as a simple Hex dump but we have given a number of checks to simplify the loading. The program should be loaded in using the M command from address 0400H and it is probably wise to save small chunks of it as you go, there are over 4000 characters in the listing.

The format of the dump is arranged to simplify entry and follows the format below.

```
; 18 0400 4C300AA000F002A001A640B5804A088A4A4A4A4AAA28900A 0860
```

The first two characters give the number of Hex bytes in the line, the next four characters give the starting address of the line and then you have the pairs of Hex data bytes. At the end of the line is a checksum, this is a total of *all* the Hex information excluding itself. The final line of the dump contains 0,0,No. of records and a line checksum.

The second reason for publishing the Hex dump is that the program listing in fully commented and dis-assembled form takes 25 pages of A4 paper! This listing is available for those with other systems or those who wish to modify the game, at £3.50 from our normal office address by mail order *only*. The game uses no subroutines within the monitor other than the documented input and output segments, the only major change you will have to make is to alter the memory locations of the screen to suit your particular machine, which must obviously, be 6502 based.


```
18 0400 4C300AA000F002A001A640B5804A088A4A4A4A4AAA28900A 0860
18 0418 B0CA06854180CE06D0088DC206854180C6068542A9008543 0AFC
17 0430 8544A640B5C02903AAF013464166434641664346426644 08DA
18 0447 46426644CAD0EDA640B5804A48B5C04A4AAAB5188545B528 0BF0
18 045F 8546E8851885478528854868883023A8A54149FF31459145 0AD6
17 0477 A54349FF31479147C8A54249FF31459145A54449FF3147 0AFE
18 048E 91476048A640A55238F5C0C902B009A55138F580C9039023 0B9A
17 04A6 68A8A5411145914 5A5431147914 7C8A5421145914 5A544 098F
18 04B0 11479147B5C0D0034C050A60A900206708 95C0AA68203A06 0908
18 04D5 60A5494AAAA9002AA8B9D20649FF3DE0039DE003E8B9D406 0CA2
18 04ED 49FF3DE0039DE00360A90A8549A5494AAAA9002AA8B9D206 08C0
16 0505 3DE003D018B9D4063DE103D013B9D2061DE0039DE003 09D3
18 0518 B9D4065DE1039DE10360A205A000B559F006CA10F74C050A 0A64
16 0533 A5494A9001C838F55FD00FB56539D206F0E8A9FF9559 0BE3
18 0549 208B0760C9FFD0DCB56539D406D0EDF0D320AC05A9008540 0CD8
17 0561 A54A854BA908854CA640A54B95C0A54C9580200304E640 0A3C
18 0578 A54C186906854CC93790E6A548 38E904854BA540C940D0D5 0BCC
17 0590 20F604A54AC92590 12A21BA006B9D6069DC003CA300588 0A24
18 05A7 10F430F060ADF0BFA2FFA0006901EAD0FB9D0002990003CA 0009
16 05BF C8D0F160A56EF002C66EE640A640E040F031B5C0F0F4 0EA2
17 05D5 200704A640F680A54DD004D680D680A54EF002D6C0B5C0 0CDA
18 05EC C901D00BA449C89838F580C9039004200304604C050AA900 0993
17 0604 854E8540A2E0A54DD011BD00031D0002D01A8A38E920AA 094C
17 061B B0F190ACBD1F031D1F02D0098A38E920AAB0F19098A54D 0B3E
18 0632 4901854DE64ED091A4558A3035B1532556D005A900855260 0A1D
17 064A A55649FF31539153 8AF0F0A900E65246566A46566AF013 0B6C
17 0661 8556A552C938B0DCA55338E9208553B002C654A5563153 0B39
18 0678 D007A5561153915360A652E03490034C1A09A23FB5C0F014 0A78
17 0690 A55238F5C03010C902B009A55138F580C9039007CA10E5 0B1A
18 06A7 A200F09FA5404886402007 04A640206708A90095C0688540 09B4
18 06BF 4C4506607080904050101080A0202090807060E080400000 0A14
18 06D7 000000FFFFFFA005B9590030048810F860B5C038E901484A 0AF6
17 06EF 4A995900B5801869014A0980995F006829032AAAB00A07 0800
18 0706 9965006040801020040801 02A205B5591004CA10F9608459 0788
```

```
17   071E   B9180085688B92800856CB55F08297F955FA8B168B283029      08CC
18   0735   3565D006A9FF955930D9B168B55659168A90016652A16652A      0A28
17   074D   F00F9565D659A568B186920856B9002E66CA56CC904F0D5      0BBB
18   0764   B168B3565D008B168B1565916BD0A6B559D00CB56529F0F006      0C2C
18   077C   208B074C3907B565516B916B4C18078A48984820D604A549      08B0
18   0794   4AAAA9002AA8BDE00348B9F9079DE003E8C8C8C00690EF8A      0D8A
18   07AC   48A905856BA2FF8AA8A56F29FD8DF2BF4910856F88D0FDCA      0E68
18   07C4   D0EDC668D0E7A9012001 08A56F29EF856F68AA689DDF0368      0CDC
18   07DC   9DDE03689DDD0320F604F838A53CE901853CB0034C050AD8      0B1A
18   07F4   68A868AA602408609004 18A90F856BA2FF88D0FDADF3BF0A      0CD4
17   080C   857E2902D007CAD0F0C66BD0EA608DF3BFBD61098570E8      0D48
18   0823   BD61098571A0FFC8E8BD6109F0049170D0F5ADF0BF60A200      0DEE
17   083B   BC5F088DF3BFB538484A4A4A4A 186930992002C868290F      08ED
18   0852   6930992002C8E8E008D0DEF0D60806040C101816144488A48      095C
17   086A   4A4A4A4AAAF8A552C934B00818BDB10865388538A53948      0A0D
17   0881   69008539A53A6900853A68453929E0F008A53CC904F002      0955
18   0898   E63CA552C934B00CA53B38E901853BD0034C7D0AD868AA68      0B44
17   08B0   6050403020A5784AAAA9002AA8E00E9068E033B064E012      0A9A
18   08C7   903FE02EB03BB9340949FF3D30029D30028468A57DF00CC8      0B00
16   08DF   984AB00E888888884CF108C8984A90F6C8C8C00AB011      0C4D
18   08F5   B934093D3002D01DB934091D30029D3002A468C8C8E8C00A      09CC
16   090D   90B6E678A57DD004C678C67860206708A9008552A21F      0A72
18   0923   9D4002CA10FAA9008578A56F29F7856F600000B8203F7E74      0A2E
17   093B   BD0010C67AD01EC67BD01AA905857BA91CA64D867DD002      0ABC
11   0952   A9638578A91E8579A56F0908856F604802      06FD
14   0963   494E564153494F4E20434F4D504C455445008903      05EC
11   0977   505245535320504C4159204B4559004902      04C8
17   0988   535041434520494E564153494F4E009102313030000D102      0692
14   099F   353000110334300051033330009103323000C303      040C
18   09B3   43542C4554492C2843295441 4E474552494E452031393830      06C8
18   09CB   00008B02B83F7400CC021810000C031C14004C032C04008C      0524
18   09E3   032404000020AC05A225201A08E8BD6109D0F7A26C201D08      0832
18   09FB   E88D6109D0F720FF0760A200D8201A08A210A90F9D6802CA      0B6F
18   0A13   10FA20FF07A202B53DD5389005D02BCA10F5A202B5389 53D      0ACA
17   0A2B   CA10F9301DD8A900A2CF9530CAD0FBA20FA900A0029518      0B61
16   0A42   9428186920900 1C8CA10F3A2FF9A20E80978A930854A      0A51
16   0A58   205A05A21420 1A08A9008539853A8538A903853CA901      06E9
18   0A6E   8DF2BF20390820FF07ADF3BF4A90D0A902200108A2FFD89A      0C45
17   0A86   A964853BA905857B856FA00 1846D844F845088844D844E      0A7A
17   0A9D   8457845284788458888A2059459CA10FB205A05A9FF8540      0B24
17   0AB4   C64AC64AA9FF457EA888D0FDC650D03320C305A9088550      0CE4
18   0ACB   203E09A56ED025A54ED021A5402907186938AAB5C0D0068A      0A8D
18   0AE3   38E908B0F520DD06A67ABD300A297F653B4A856EC64FD031      0B88
17   0AFB   E64FADF3BF2904F014A649E002F02220D604C64920FA04      0BE8
18   0B12   A910854FD014ADF3BF2902F00DA649E03AF00720D604E649      0B56
17   0B2A   D0E3A201A552D03FADF3BF2908D008C658104BE658F047      0BFE
18   0B41   A558D043203E09A9038554A9E08553A649E886518A4A8555      0B1D
18   0B59   A56F29FB856FA904900 10A8556A9028552A2008657CA300A      09D0
17   0B71   A56F0904856FA557D00B203A06A9068557A9028558C657      090F
18   0B88   ADF3BF2910F018A0FFA9058DF2BFADF3BF2910D0F288D0F6      0F7E
16   0BA0   ADF3BF290FF0F9C66DD00B201207A53B4A4A690A856D      0A61
18   0BB6   203908A56F8DF2BFA902C550D01FC67CD01BA204A002A56F      0BC4
17   0BCE   2902F00A8888A56F4902856FA63B867C98056F856FA578      0A78
10   0BE5   F008C679D007A91E8579208 5084CB80A      07C1
 0   0      0059      0059
```

Henry Budgett

For the first time ever: full details on the graphics sets and other vital conversion facts for all the most popular micros! Makes running programs easy whatever the machine.

Many currently available personal microcomputers are equipped with memory mapped screens and graphics character sets. These facilities allow the user to produce pictorial and graphic displays, (the resolution generally being somewhat crude) and play all those interesting games. But, what if you want to translate a program written for another machine which uses another graphics set and has a different screen memory area? Up till now this has been a difficult task and its success has tended to depend on the quality of the documentation supplied with the published software.

Now, if you had a series of charts showing all the standard codes and screen positions, you could look up on the appropriate one, cross reference to your machine and select the correct graphic and its code. Here we give a selection of graphics sets belonging to some of the more popular machines along with a variety of useful notes. But before we dive in, it is necessary to explain where they all came from.

The ASCII Set

The standard character code set for computers is known as ASCII, the acronym for American Standard Code for Information Interchange.

It is based around a seven bit natural binary sequence thus providing a total of 127 different alphanumeric and control codes. Although $2^8 = 128$ we usually regard "all zeroes" and "all ones" as NULL codes hence the figure of 127 unique codes. In many systems an 8 bit code is used with the extra bit functioning as a parity check.

The first table gives the complete ASCII character set but it is important to bear in mind that this and all the subsequent tables are printed as they would be written on paper, (black on white) whereas the VDU displays everything in white on black: so you must mentally reverse everything in order to 'see' what it looks like on the screen.

The ASCII codes from 1 to 32 have special control functions. The ones of most use to the general programmer are as follows; 7-Bell, 10-Line feed, 12-Form feed (can be used as a Clear screen), 13-Carriage return, 32-Space. On some machines, notably those of US origin, code 35 will be a #(hash) symbol.

CODE	SYM-BOL	CODE	SYM-BOL	CODE	SYM-BOL	CODE	SYM-BOL
0	NUL	32	SP	64	@	96	
1	SOH	33	!	65	A	97	a
2	STX	34	"	66	B	98	b
3	EXT	35	£	67	C	99	c
4	EOT	36	$	68	D	100	d
5	ENQ	37	%	69	E	101	e
6	ACK	38	&	70	F	102	f
7	BEL	39	'	71	G	103	g
8	BS	40	(	72	H	104	h
9	HT	41	)	73	I	105	i
10	LF	42	*	74	J	106	j
11	VT	43	+	75	K	107	k
12	FF	44	,	76	L	108	l
13	CR	45	-	77	M	109	m
14	SO	46	.	78	N	110	n
15	SI	47	/	79	O	111	o
16	DLE	48	0	80	P	112	p
17	DC1	49	1	81	Q	113	q
18	DC2	50	2	82	R	114	r
19	DC3	51	3	83	S	115	s
20	DC4	52	4	84	T	116	t
21	NAK	53	5	85	U	117	u
22	SYN	54	6	86	V	118	v
23	ETB	55	7	87	W	119	w
24	CAN	56	8	88	X	120	x
25	EM	57	9	89	Y	121	y
26	SUB	58	:	90	Z	122	z
27	ESC	59	;	91	[	123	{
28	FS	60	<	92	\	124	!
29	GS	61	=	93	]	125	}
30	RS	62	>	94	↑	126	~
31	US	63	?	95	←	127	DEL

The ASCII code set. Codes 0 to 31 are non-printing and are used to control external devices.

Character Codes

All the alphagraphic code sets are similar in a number of ways to the ASCII set in that their alphanumeric codes follow the same sort of pattern, code E being a number four greater than code A for example. In general the first 31 codes are used for graphics as are the extra 127 codes not used by the ASCII set. It should be noted at this point that these numbers are *not* replacements for the ASCII code but numbers to be used in conjunction with the BASIC PEEK and POKE commands which access a referenced location in memory. If you wish to use the ASCII set then the BASIC function CHR($) should be used, for example PRINT CHR$ (12) clears the screen by using the appropriate ASCII control code, whereas POKEing code 12 would output the respective graphic character. This apparent quirk is a trap for the unwary but a little practice soon prevents the silly mistakes.

GRAPHIC DETAILS

CODE	SYM-BOL	CODE	SYM-BOL	CODE	SYM-BOL	CODE	SYM-BOL	CODE	SYM-BOL	CODE	SYM-BOL	CODE	SYM-BOL	CODE	SYM-BOL
0		32	SP	64	@	96	—	128		160		192		224	
1		33	!	65	A	97	a	129		161		193		225	
2		34	"	66	B	98	b	130		162		194		226	
3		35	£	67	C	99	c	131		163		195		227	
4		36	$	68	D	100	d	132		164		196		228	
5		37	%	69	E	101	e	133		165		197		229	
6		38	&	70	F	102	f	134		166		198		230	
7		39	'	71	G	103	g	135		167		199		231	
8		40	(	72	H	104	h	136		168		200		232	
9		41	)	73	I	105	i	137		169		201		233	
10		42	*	74	J	106	j	138		170		202		234	
11		43	+	75	K	107	k	139		171		203		235	
12		44	,	76	L	108	l	140		172		204		236	
13		45	—	77	M	109	m	141		173		205		237	
14		46	.	78	N	110	n	142		174		206		238	
15		47	/	79	O	111	o	143		175		207		239	
16		48	0	80	P	112	p	144	PIXEL CHARACTERS	176	PIXEL CHARACTERS	208		240	
17		49	1	81	Q	113	q	145		177		209		241	
18		50	2	82	R	114	r	146		178		210		242	
19		51	3	83	S	115	s	147		179		211		243	
20		52	4	84	T	116	t	148		180		212		244	
21		53	5	85	U	117	u	149		181		213		245	
22		54	6	86	V	118	v	150		182		214		246	
23		55	7	87	W	119	w	151		183		215		247	
24		56	8	88	X	120	x	152		184		216		248	
25		57	9	89	Y	121	y	153		185		217		249	
26		58	:	90	Z	122	z	154		186		218		250	
27		59	;	91	←	123	¼	155		187		219		251	
28		60	<	92	½	124	‖	156		188		220		252	
29		61	=	93	→	125	¾	157		189		221		253	
30		62	>	94	↑	126	÷	158		190		222		254	
31		63	?	95	#	127	■	159		191		223		255	

RML 380Z

Screen memory:- 61440-62209
F000H-F5FFH

Format:- 24 lines of 40 characters with a 25 character (19H) margin on the right-hand side of the screen. These positions will display but in a non-ordered fashion and are best ignored.

Notes:- Apart from the usual PEEK and POKE commands the RML Extended BASIC offers several graphics commands as follows; GRAPH-sets the top 20 lines to graphics mode, leaving the bottom four for scrolled text, TEXT-resets the screen to full scrolling, PLOT-used for plotting points, characters or strings in the top 20 lines with the bottom left corner being reference 0,0 and the top right being 79,59. LINE-draws a straight line from the last co-ordinates to the specified position, POINT-returns the character value stored at the given location. All the graphics characters can be plotted in two 'shades' of white.

CODE	SYM-BOL	CODE	SYM-BOL	CODE	SYM-BOL	CODE	SYM-BOL	CODE	SYM-BOL	CODE	SYM-BOL	CODE	SYM-BOL	CODE	SYM-BOL
0		32	SP	64	@	96		128		160		192		224	
1		33	!	65	A	97		129		161		193		225	
2		34	"	66	B	98		130		162		194		226	
3		35	#	67	C	99		131		163		195		227	
4		36	$	68	D	100		132		164		196		228	
5		37	%	69	E	101		133		165		197		229	
6		38	&	70	F	102		134		166		198		230	
7		39	'	71	G	103		135		167		199		231	
8	BS	40	(	72	H	104		136		168		200		232	
9		41	)	73	I	105		137		169		201		233	
10	LF	42	*	74	J	106		138		170		202		234	
11	FF	43	+	75	K	107		139		171		203		235	
12	FF	44	,	76	L	108		140		172		204		236	
13	CR	45	-	77	M	109		141		173		205		237	
14	CURON	46	.	78	N	110		142		174		206		238	
15	CUROF	47	/	79	O	111		143		175		207		239	
16		48	0	80	P	112		144		176		208		240	
17		49	1	81	Q	113		145		177		209		241	
18		50	2	82	R	114		146		178		210		242	
19		51	3	83	S	115		147		179		211		243	
20		52	4	84	T	116		148		180		212		244	
21		53	5	85	U	117		149		181		213		245	
22		54	6	86	V	118		150		182		214		246	
23	32/64	55	7	87	W	119		151		183		215		247	
24	[CL]	56	8	88	X	120		152		184		216		248	
25	[CR]	57	9	89	Y	121		153		185		217		249	
26	[CD]	58	:	90	Z	122		154		186		218		250	
27	[CU]	59	;	91	↑	123		155		187		219		251	
28	[HOM]	60	<	92	↓	124		156		188		220		252	
29		61	=	93	←	125		157		189		221		253	
30	ERL	62	>	94	→	126		158		190		222		254	
31	ERF	63	?	95	—	127		159		191		223		255	

NON DISPLAYABLE CHARACTERS

PIXEL CHARACTERS

PIXEL CHARACTERS

CHARACTER COMPRESSION CODES

CHARACTER COMPRESSION CODES

Tandy TRS-80 Model 1

Screen memory:- 15360-16383
3C00H-3FFFH

Format:- 16 lines of 64 characters, selectable to 32 characters.

Notes:- Character codes from 0 to 31 are control codes. Notable ones are; 14-Cursor on, 15-Cursor off, 23-32/64 character select, 29-Reset cursor to start of line, 30-Erase to end of line, 31-Erase to end of frame. Pixel graphics are accessed by codes 129 to 191 inclusive and the remaining 64 are used as TAB generators from 0 spaces to 63 spaces for space commission in programs.

GRAPHIC DETAILS

CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL
0	@	32	SP	64	─	96	SP	128	@	160	SP	192	─	224	SP
1	A	33	!	65	♠	97	▌	129	A	161	!	193	♠	225	▌
2	B	34	"	66	┐	98	▬	130	B	162	"	194	┐	226	▬
3	C	35	#	67	─	99	▀	131	C	163	#	195	─	227	▀
4	D	36	$	68	─	100	▁	132	D	164	$	196	─	228	▁
5	E	37	%	69	┌	101	▏	133	E	165	%	197	┌	229	▏
6	F	38	&	70	─	102	▒	134	F	166	&	198	─	230	▒
7	G	39	'	71	└	103	▔	135	G	167	'	199	└	231	▔
8	H	40	(	72	┘	104	▒	136	H	168	(	200	┘	232	▒
9	I	41	)	73	╱	105	◢	137	I	169	)	201	╱	233	◢
10	J	42	*	74	╲	106	▐	138	J	170	*	202	╲	234	▐
11	K	43	+	75	╳	107	▐	139	K	171	+	203	╳	235	▐
12	L	44	,	76	┌	108	▖	140	L	172	,	204	┌	236	▖
13	M	45	─	77	╲	109	▗	141	M	173	─	205	╲	237	▗
14	N	46	.	78	╱	110	▘	142	N	174	.	206	╱	238	▘
15	O	47	/	79	┐	111	▂	143	O	175	/	207	┐	239	▂
16	P	48	0	80	┐	112	▚	144	P	176	0	208	┐	240	▚
17	Q	49	1	81	○	113	▞	145	Q	177	1	209	○	241	▞
18	R	50	2	82	─	114	▛	146	R	178	2	210	─	242	▛
19	S	51	3	83	♥	115	▜	147	S	179	3	211	♥	243	▜
20	T	52	4	84	┌	116	▌	148	T	180	4	212	┌	244	▌
21	U	53	5	85	╱	117	▙	149	U	181	5	213	╱	245	▙
22	V	54	6	86	╳	118	▟	150	V	182	6	214	╳	246	▟
23	W	55	7	87	○	119	▄	151	W	183	7	215	○	247	▄
24	X	56	8	88	♣	120	▄	152	X	184	8	216	♣	248	▄
25	Y	57	9	89	┐	121	▆	153	Y	185	9	217	┐	249	▆
26	Z	58	:	90	◆	122	▁	154	Z	186	:	218	◆	250	▁
27	[	59	;	91	┼	123	▖	155	[	187	;	219	┼	251	▖
28	\	60	<	92	▒	124	▘	156	\	188	<	220	▒	252	▘
29	]	61	=	93	┐	125	▗	157	]	189	=	221	┐	253	▗
30	↑	62	>	94	π	126	▝	158	↑	190	>	222	π	254	▝
31	←	63	?	95	◥	127	▚	159	←	191	?	223	◥	255	▚

Screen memory:- 32768-33767
8000H-83E7H

Format:- 25 lines of 40 characters

Notes:- Graphics characters may be converted to lower case alphabetics with POKE 59468,14 and back with POKE 59468,12. CHR$ (147) clears the screen. Note that when outputting screen based information the PET uses an absolute TAB rather than spaces which can disrupt apparently neat formats. For full and well explained details on the PET see the 'PET Revealed' from Computabits, price £10.

Commodore PET

GRAPHIC DETAILS

CODE	SYM-BOL	CODE	SYM-BOL	CODE	SYM-BOL	CODE	SYM-BOL	CODE	SYM-BOL	CODE	SYM-BOL	CODE	SYM-BOL	CODE	SYM-BOL
0		32	SP	64	@	96	♠	128	SP	160	q	192	SP	224	
1		33	!	65	A	97	H	129		161	a	193		225	
2		34	"	66	B	98	H	130		162	z	194		226	
3		35	#	67	C	99		131		163	w	195		227	
4		36	$	68	D	100		132		164	s	196		228	
5		37	%	69	E	101		133		165	u	197		229	
6		38	&	70	F	102		134		166	i	198		230	
7		39	'	71	G	103	●	135		167	≡	199		231	
8		40	(	72	H	104		136		168	Ö	200		232	
9		41	)	73	I	105		137		169	k	201		233	
10		42	*	74	J	106		138		170	f	202		234	
11		43	+	75	K	107		139		171	v	203		235	
12		44	,	76	L	108		140		172	|||	204		236	
13		45	−	77	M	109		141		173	ü	205		237	
14		46	.	78	N	110		142		174	β	206		238	
15		47	/	79	O	111		143		175	j	207		239	
16		48	0	80	P	112		144		176	n	208		240	
17		49	1	81	Q	113		145		177		209		241	
18		50	2	82	R	114		146	e	178	Ü	210		242	
19		51	3	83	S	115		147		179	m	211		243	
20		52	4	84	T	116		148		180		212		244	
21		53	5	85	U	117		149		181		213		245	
22		54	6	86	V	118		150	t	182		214		246	
23		55	7	87	W	119		151	g	183	o	215		247	
24		56	8	88	X	120		152	h	184		216		248	
25		57	9	89	Y	121		153		185	Ä	217		249	
26		58	:	90	Z	122		154	b	186	ö	218		250	
27		59	;	91	[	123	○	155	x	187	ä	219		251	
28		60	<	92	¥	124		156	d	188		220		252	
29		61	=	93	]	125		157	r	189	y	221		253	
30		62	>	94	↑	126		158	p	190		222		254	
31		63	?	95	←	127		159	c	191		223		255	

Sharp MZ-80K

Screen memory:- 53248-54247
D000H-D3E7H

Format:- 25 lines of 40 characters

Notes:- Taking the top left hand corner of the screen as co-ordinate 0,0 the commands SET and RESET can be used to turn on or off any cell on a 50 by 80 grid thus allowing limited double density plotting. Normal graphics codes are accessed by POKE, CHR$(198) performs a [CLS].

THE WORLD'S FINEST HOBBY COMPUTING SOFTWARE

STOP PRESS! AVAILABLE NOW — CEGMON, the ultimate Compukit monitor ROM. Amazing features many £3,000 computers can't match. Send today for details.

MASTER PACK

MASTER PACK

for the TRS 80 Level II COMPUKIT UK 101 SHARP MZ-80 OHIO SUPERBOARD VIDEO GENIE CASIO 501/502P

UTILITIES PACK for Compukit UK101 and Ohio Superboard (all screen formats)

Sixteen utility programs that will revolutionise your programming techniques. All programs feature NEW logical screen address system (line 1 column 1 is address 101) with FULL protection against under/over poking.

✱ Simple and complex graphics created with single GOSUB calls ✱ Inputs displayed at any screen address without scrolling ✱ Strings displayed at any screen address without scrolling ✱ Full page of strings displayed by defining just one variable ✱ TEXTRA text display - a full screenful of text displayed direct from the keyboard ✱ Graphics Design Toolkit - 'Graphics Underlay' and 'Screen Address Indicator' to speed your graphics design ✱ Precision Random Number Generator - a great improvement on Microsoft's RND ✱ Instant clear and fill screen and other invaluable routines ✱ Modular design to minimise RAM needed (full pack 1300 bytes - 500 - 600 bytes in typical applications) ✱ Written entirely in BASIC for easy customisation ✱ Comprehensive operating instructions and demonstration program.

Our best-selling UK101/SUPERBOARD program pack!
NOW ONLY £14.95 including VAT

STRATEGY GAMES PACK for TRS 80 (16K), Video Genie, Compukit UK101 (8K), Ohio Superboard (standard screen, 8K), and Sharp MZ-80K

Three extra-special games GUARANTEED to appeal to enthusiasts who want something a little more thought-provoking than Space Invaders!

✱ SQUARE SOLITAIRE - Solitaire brought up to date. Unique REPLAY feature gives you a slow-motion replay of all your moves, and allows you to resume play at any point, helping you to develop winning strategy. Incredible graphics!

✱ NINE-IN-A-LINE - The age-old game of Reverse with new and challenging variations to keep you engrossed for hours.

✱ EXECUTIVE JIGSAW - An entirely new game that's as frustrating as it is fascinating. Use your skill to exactly fill the jigsaw frame. Great fun (even if you don't like ordinary jigsaws).

Other leading software publishers would probably ask £8-£12 for just one of these 'Rolls-Royce' games. But PREMIER's value-for-money price is only £12.95 for all THREE, and that includes VAT.

TO ORDER: Enjoy the ultimate demonstration of program quality - in your own home on your own computer, with the security of our 10-day money-back guarantee of satisfaction

UK: Just send cheque/PO to include 50p to cover post, packing and insurance.

OVERSEAS: Please deduct VAT (divide price by 1.15) and add postage for 200 grams weight OR send two International Reply Coupons for quotation/program details.

Orders normally despatched within five working days
PLEASE SPECIFY YOUR COMPUTER WHEN ORDERING

PREMIER software is available ONLY direct from PREMIER PUBLICATIONS
We will be pleased to send you details of our software range for your computer - phone or write today

from Premier Publications

12 Kingscote Road Addiscombe Croydon Surrey Telephone 01-656 6156

Britain's biggest hobby software specialist - over 90 000 programs sold to date!

Dear Sir,

Ed Holson writes ("Computing Today" — September 1980) on calculating the areas of irregular shapes; the method he gives is a version of one for calculating the area of a polygon directly from the Cartesian co-ordinates of its vertices, but he is mistaken in thinking that a negative result is given by the entry of negative co-ordinates.

Whether the co-ordinates are negative or positive makes no difference to the sign of the result; a negative area will result from his formula if the co-ordinate pairs are entered in an anticlockwise direction; if the co-ordinates are entered clockwise the output will be positive.

I have used the following formula successfully for years, but it has an anticlockwise bias and will return a negative answer if the input is clockwise:

$A = ½(x1y2 - x2y1 + x2y3 - x3y2 + \ldots\ldots + xny1 - x1yn)$

. . . but another version more like Ed Holson's, but with an anticlockwise bias is:

$A = ½((x1 + x2)y2 - y1) + (x2 + x3)y3 - y2) + \ldots\ldots + (xn + x1)(y1 - yn))$

The problem is easily overcome (at least with the Texas Instruments SR-56, TI-57 and TI-59 which I have programmed for this calculation) by using the 'x' key calling for the absolute value of the answer.

With any of the formulae, although the number of points which can be entered is theoretically unlimited, practical consideration dictate a maximum number with manual entry and this must be decided by the user when non-polygons are having their areas approximated on the basis of time and convenience against desired accuracy.

Yours faithfully,
Tiger Redman.

Orley Farm School,
Harrow, Middx.
HA1 3NU.

Dear Ed,

Surely, I am not the only person to notice misprints in many programs that you print. Most of these are easily identified providing the listing is in BASIC — a particularly bad example I found to be "LIFE" published in August 1980 for UK101.

However, machine code listings are not so easy to debug unless one is very familiar with this form of programming. Please tell me where the misprint(s) are in "Othello" (September 1980) — NASCOM with NAS-SYS. I have checked for all possible mistakes on my part and have cleared this point. The game will run OK but the player is not allowed to make any more involving the top line of the board.

Hoping that you can help in this respect.
Yours faithfully,
R.M. Dowling.

11 Westbrooke Road,
Welling, Kent.
DA16 1PR.

Dear Sir,

Since I have recently learnt Pascal and found it a great improvement upon BASIC, I was surprised to read Mr. Stephenson's critique of the language in the September 1980 issue of Computing Today.

As Mr. Stephenson states BASIC was conceived in 1964, when computer hardware and software was less advanced than today. At that time the dominant language was FORTRAN (little more than an advanced and standardised assembler) and BASIC was a development of this. Due to its "relaxed" definition no program written in BASIC is portable without extensive alteration. Pascal however, having been "rigidly defined" is the same on most computers with the language. Had Pascal been the standard language for personal computers, there would have been no need for articles explaining the differences between the various dialects.

In 1964 a language may have had to be "simple or efficient"; today it should be both simple AND efficient. I believe that Pascal has these properties. Being a compiled language, programs run much faster and on the system I use all syntax errors are printed in "plain language" when the program is compiled rather than as the erroneous statements are executed. There is no need to "delve into the mysteries of the machine code" as this has been done by the compiler writer.

All computer languages are a compromise between machine code and English. In my opinion the measure of a language is how close it is to a definition of the problem in English. The first step in writing any program is to write a rigid set of rules to solve the problem. (An algorithm). This may be easily translated to a structured language such as Pascal since English is, by its nature, structured. To translate an algorithm to BASIC it is first necessary to draw a flowchart and then to 'code' the flowchart into BASIC. Although Mr. Stephenson may enjoy obtuse programming, I would not regard this as good practice. The programmer himself may wish to alter his program weeks or months after writing it and if the program is structured his task will be greatly simplified. A particular advantage of Pascal is that subroutines and functions are named and may be filed away for use in many programs without alteration. I regard having to number every line as more of a "straitjacket" than the limited restrictions of structured programming.

I did not find Pascal a difficult language to learn. It took me a week of evenings to learn Pascal from a textbook on the subject, having had some previous experience in BASIC and machine code programming. I hope that Computing Today will publish programs in Pascal as well as BASIC for the benefit of the increasing number of Pascal programmers.

Yours sincerely,
Richard Parratt.

22 Rozeldene,
Hindhead,
Surrey GU26 6TW.

Dear Editor,

I'd like to report the following errors in CONLAN Interpreter in the August issue:

Line 205 IF A$ = "E" THEN 130
should be IF A$ = "E" THEN 120
Line 330 FOR J(J) = 1 THEN PRINT J$(J);"*";
should be IF J(J) = 1 THEN PRINT J$(J);"*";

This program contains several bugs which will become apparent once any use is made of it:

1. It does not terminate! The solution to this is simply to add another system command, for example, QUIT; test for it and STOP.
2. No checks are made for any of the arrays going out of bounds — just sloppy programming as it is simple to do this sort of checking.

On the whole, the program does very little syntax checking; and it does not, as specified, take any action when commas and colons are included in the CONLAN program or input.

It is possible to write well structured programs in BASIC, so please try harder; your readers deserve better software!

Yours faithfully,
Cornelia Boldyreff.

South West Universities
Regional Computer Centre,
University of Bath,
Claverton Down,
Bath BA2 7AY.

Dear Sirs,

The Othello program in the September 1980 issue of CT contains two errors, one of which is serious, as it results in the program refusing to let one play on the top line. To cure this, the following changes should be made:

0D93	change from	31 to 30
0D98	— " —	08 to 09
0D9D	— " —	08 to 09
0DB9	— " —	DA to 9A

Less serious is the use of FF Hex as the white piece in the game; this has annoying effects when used on a Nascom fitted with graphics. As I said in INMC News (the ONLY other computer magazine) in the first episode of Doctor Dark's Diary, "just because bit 7 isn't displayed, it doesn't mean it doesn't matter".

On the other hand, if the program was rewritten to take account of this it would not fit into an unexpanded Nascom, which would upset a lot of people.

Yours faithfully,
Chris Blackmore.
Alias Doctor Dark.

31 Herne Rise,
Ilminster,
Somerset TA19 0HH.

P.S. Diego Rincón is right about Personal Computer World binders!

Dear Sir,

Over the past year I have noticed an increasing attack on BASIC — in the majority of cases by academics and professional programmers who are concerned with the higher levels of programming.

I was interested to read the article 'Pascal, A False Idol' in the Sept 1980 issue, and was pleased to see the support for BASIC.

As stated BASIC brought computing to the masses.

BASIC satisfies virtually all of the needs of the micro user — the hobbyist and small business user and is understandable and useable right from the start of computing through to very extensive programs.

Very little team programming is done on micros — it is individuals enjoying themselves who have pushed micro computing to the level it is at now and who will take it further in the coming years.

All strength to your support for BASIC.

Yours faithfully,
R.F. Cox.

14 Craighill Road,
Leicester. LE2 3FA.

Dear Sir,

With reference to Matthews & Matthews solution to rounding to 2 decimal places (Aug 1980, page 10), this solution does not work. The solution given is

X=INT ((X + .001)* 100)/100

Putting X=5.996 for example rounds to 5.99, not 6.00.

A general solution which does work is given below. For convenience it is parametised, R is the accuracy required. For example put R=0.01 for 2 decimal places; R=100 for rounding to the nearest 100. It even works for things like R=0.5 for rounding to the nearest 0.5 or R=25 for rounding to the nearest 25!

```
10 R=0.01: REM ROUNDING TO 2 DEC
   PLACES
.
.
.
500 X=INT (X/R + 0.5)* R
```

Eg INT(5.996/0.01 + 0.5)*0.01
= INT (599.6 + 0.5)* 0.01
= INT (600.1)* 0.01
=6.00 as required.

As another example 127 to nearest 50 (R=50) gives INT(127/50 + 0.5)*50 = INT(2.54 + 0.5)*50 = 3*50
= 150

Putting R=25 in the same case gives INT (127/25 + 0.5)*25 = 125. This accuracy is given to the nearest 50 or 25 as required.

Finally, I would just like to say that despite (or perhaps because of) the errors which inevitably occur in something like "PRINTOUT" I think that this medium for exchanging views is invaluable to all who take an active interest in computers.

Yours faithfully,
D.S. Mear.

2 Burnt House Rd.,
West Monkseaton,
Tyne & Wear
NE25 9DZ.

Dear Editor,

I am writing this letter by way of an appeal for information. I own an Acorn Atom and since the BASIC is so unusual, it means I have to write all my own software. I have been reading an awful lot about "Life" (or so it seems) recently, but for a person like me who has never seen the game, there is insufficient explanation to try and implement it on my Atom (which is a pity since from the rave reviews it seems quite good). Could some reader out there enlighten a poor uninformed soul about the game please?

Also could you try and include at least a flowchart, or preferably a little article, with all games programs in future for unfortunates such as myself.

I would also like to hear from anyone else who may own one of the said systems, possibly with a view to exchanging software.

Yours faithfully,
L. Nolan.

99 Fir Street,
Cadishead,
Manchester. M30 5AR.

Dear Sir,

I write in defence of your excellent 'Battle of Britain' program. I typed it into my TRS-80 (4K L1) modding it as I went and — after correcting the usual idiot errors — it ran immediately. I was just very grateful to find a program that didn't PEEK and POKE every other line. It would not have helped me to know the types of BASIC — it might even have dissuaded me from trying to use it.

I enjoy your 'pretty pictures' they give some atmosphere to the otherwise tedious business of program input. Keep up the good work.

How about printing a glossary of the effects of the most common PEEKs and POKEs from, say, PET and UK101 (the most common offenders).

Yours faithfully,
Clive L. Corner.

White Gable,
Walkwood End,
Beaconsfield, Bucks.

Dear Sir,

I have a UK101, and would like to comment on two recent items in CT.

1) July 1980 — Decimal Point (p.61) The routine given does not work for values very close to 10 — e.g. 9.99999 is printed one position too far left. This can be corrected by replacing the approximation "0.4343" with its exact value, i.e. "log 10".

2) August 1980 — Letter on use of INT (p.11). My problems with the use of INT always seem to occur when the number being operated on is the result of a subtraction for example, 10.345 — 10.000 gives, not 0.346 but 0.344999. Then, rounding off with (INT(x*100 + .5))/100 gives 0.34 instead of 0.35. I have noticed that this type of error (presumably due to the "guard" digit) does not seem to occur when whole numbers are being used, and not decimals. Also, converting a number to a string and back again seems to correct any wrong guard digits.

The following routine gives the correct value of (X − Y) for all the combinations I have tried so far:-

```
100  M=0
110  IF ABS(X)>999999 OR ABS(Y) >
     999999 X=X/10: Y=Y/10: M=M+1:
     GOTO 110
120  IF ABS(X)<100000 AND ABS(Y)<
     100000 THEN X=10*X: Y=10*Y:
     M=M−1: GOTO 120
130  X=VAL(STR$(X)): Y=VAL(STR$(Y))
140  Z=X−Y
150  IF M>0 THEN FOR I=1 TO M:
     Z=10*Z: NEXT
160  IF M<0 THEN FOR I=1 TO −M:
     Z = Z / 10 NEXT
```

Yours faithfully,
A.E. Wilmshurst.

Summerhill,
Coopers Lane,
Crowborough,
East Sussex.

Dear Sir,

Many schools have recently installed micro computers, and have now found that hardware is of little use without good software. As you will know, there is a dearth of good educational software, and while this situation will no doubt improve in the future, the present problem still exists.

At the last meeting of the British Computer Society's Schools Committee — Resources Working Party, it was felt that some immediate aid was required. The Working Party decided to make available 'Starter Tapes' for the most commonly available machines. The first of these is for the PET, and contains a number of games and educational programs from various areas. It is intended to help teachers, who are new to computing, to explore the capabilities of their machines.

Teachers may obtain a copy of this tape by sending a strong brown self-addressed envelope and a cheque for £2 (made out to The Upper School, Stirchley) to the address below:-

The British Computer Society,
c/o The Upper School, Stirchley,
Stirchley District Centre,
Telford, Shropshire.

Many teachers are also unaware that they may seek assistance from their local BCS Schools Liaison Officer. They may find out how to make contact with this person by writing to the BCS headquarters in London.

If you can find space in your magazine to print this letter I would be most grateful.

Yours faithfully,
Trevor Lusty,
BCS Schools Committee.

13 Mansfield Street,
London W1M 0BP.

CAMBRIDGE LEARNING SELF-INSTRUCTION COURSES

It's faster and more thorough than classroom learning: you pace yourself and answer questions on each new aspect as you go. This gives rare satisfaction – you know that you are really learning and without mindless drudgery. With a good self-instruction course you become your own best teacher.

Understand Digital Electronics

In the years ahead digital electronics will play an increasing part in your life. Calculators and digital watches mushroomed in the 1970's -soon we will have digital car instrumentation, cash cards, TV messages from friends and electronic mail.

After completing these books you will have broadened your career prospects and increased your knowledge of the fast-changing world around you.

DIGITAL COMPUTER LOGIC AND ELECTRONICS £7.00

This course is designed as an introduction to digital electronics and is written at a pace that suits the raw beginner. No mathematical knowledge is assumed other than the use of simple arithmetic and decimals and no electronic knowledge is expected at all. The course moves painstakingly through all the basic concepts of digital electronics in a simple and concise fashion: questions and answers on every page make sure that the points are understood.

Everyone can learn from it - students, engineers, hobbyists, housewives, scientists. Its four A4 volumes consist of:

Book 1 Binary, octal and decimal number systems; conversion between number systems; conversion of fractions; octal-decimal conversion tables.

Book 2 AND, OR gates; inverters; NOR and NAND gates; truth tables; introduction to Boolean algebra.

Book 3 Positive ECL; De Morgans Laws; designing logic circuits using NOR gates; dual-input gates.

Book 4 Introduction to pulse driven circuits; R-S and J-K flip flops; binary counters; shift registers; half-adders.

DESIGN OF DIGITAL SYSTEMS £12.50

This course takes the reader to real proficiency. Written in a similar question and answer style to Digital Computer Logic and Electronics, this course moves at a much faster pace and goes into the subject in greater depth. Ideally suited for scientists or engineers wanting to know more about digital electronics, its six A4 volumes lead step by step through number systems and Boolean algebra to memories, counters and arithmetic circuits and finally to an understanding of calculator and computer design.

Book 1 Octal, hexadecimal and binary number systems; conversion between number systems; representation of negative numbers; complementary systems; binary multiplication and division.

Book 2 OR and AND functions; logic gates; NOT, exclusive-OR, NAND, NOR and exclusive-NOR functions; multiple input gates; truth tables; De Morgans Laws; canonical forms; logic conventions; karnaugh mapping; three state and wired logic.

Book 3 Half adders and full adders; subtractors; serial and parallel adders; processors and arithmetic logic units (ALUs); multiplication and division systems.

Book 4 Flip flops; shift registers; asynchronous and synchronous counters; ring, Johnson and exclusive-OR feedback counters; random access memories (RAMs) and read only memories (ROMs).

Book 5 Structure of calculators; keyboard encoding; decoding display data; register systems; control unit; program ROM; address decoding; instruction sets; instruction decoding; control programme structure.

Book 6 Central processing unit (CPU); memory organization; character representation; program storage; address modes; input/output systems; program interrupts; interrupt priorities; programming; assemblers; computers; executive programs; operating systems and time sharing.

Flow Charts and Algorithms

are the essential logical procedures used in all computer programming and mastering them is the key to success here as well as being a priceless tool in all administrative areas -presenting safety regulations, government legislation, office procedures etc.

THE ALGORITHM WRITER'S GUIDE £4.00

explains how to define questions, put them in the best order and draw the flow chart, with numerous examples.

GUARANTEE No risk to you.

If you are not completely satisfied, your money will be refunded upon return of the books in good condition.

CAMBRIDGE LEARNING LIMITED, UNIT 56
RIVERMILL SITE, FREEPOST, ST. IVES, HUNTINGDON,
CAMBS., PE17 4BR, ENGLAND.
TELEPHONE: ST. IVES (0480) 67446

All prices include worldwide postage (airmail is extra - please ask for prepayment invoice).
Please allow 28 days for delivery in U.K.

Microcomputers are coming - ride the wave! Learn to program.

Millions of jobs are threatened but millions more will be created. Learn BASIC - the language of the small computer and the most easy-to-learn computer language in widespread use. Teach yourself with a course which takes you from complete ignorance step-by-step to real proficiency with a unique style of graded hints. In 60 straightforward lessons you will learn the five essentials of programming: problem definition, flowcharting, coding the program, debugging, clear documentation. Harder problems are provided with a series of hints so you never sit glassy-eyed with your mind a blank. You soon learn to tackle really tough tasks such as programs for graphs, cost estimates, compound interest and computer games.

COMPUTER PROGRAMMING IN BASIC £9.00

Book1 Computers and what they do well; READ, DATA, PRINT, powers, brackets, variable names; LET; errors; coding simple programs.

Book 2 High and low level languages; flowcharting; functions; REM and documentation. INPUT, IF....THEN, GO TO; limitations of computers, problem definition.

Book 3 Compilers and interpreters; loops, FOR....NEXT, RESTORE; debugging; arrays, bubble sorting; TAB.

Book 4 Advanced BASIC: subroutines; string variables; files; complex programming; examples; glossary.

THE BASIC HANDBOOK £11.50

This best-selling American title usefully supplements our BASIC course with an alphabetical guide to the many variations that occur in BASIC terminology. The dozens of BASIC 'dialects' in use today mean programmers often need to translate instructions so that they can be RUN on their system. The BASIC Handbook is clear, easy to use and should save hours of your time and computer time. A must for all users of BASIC throughout the world.

A.N.S. COBOL £4.40

The indispensable guide to the world's No. 1 business language. After 25 hours with this course, one beginner took a consulting job, documenting oil company programs and did invaluable work from the first day. Need we say more?

ORDER FORM

Please send me the following books:-

..... Digital Computer Logic & Electronics @ £7.00
..... Design of Digital Systems @ £12.50
..... Algorithm Writer's Guide @ £4.00
..... Computer Programming in BASIC @ £9.00
..... BASIC Handbook @ £11.50
..... ANS COBOL @ £4.40
..... Your Booklist (Free)

I enclose a *cheque/PO payable to Cambridge Learning Ltd.
for £..... (*delete where applicable)
Please charge my:

*Access/American Express/Barclaycard/Diners Club/Eurocard/Visa/ Mastercharge/Trustcard

Credit Card No.....

Signature .....
Telephone orders from credit card holders accepted on 0480 67446 (Ansafone).
Overseas customers (incl. Eire) should send a bank draft in sterling drawn on a London bank, or quote credit card number.

Name .....

Address .....

.....

.....

Cambridge Learning Limited, Unit 56, Rivermill Site,
FREEPOST, St. Ives, Huntington, Cambs PE17 4BR, England
(Registered in England, No. 1328762)

COMPUTER WAREHOUSE

NOW OPEN
MONDAY-SATURDAY
9.30-5.30

SCOOP PRINTER PURCHASE

PROFESSIONAL EQUIPMENT AT HOBBYIST PRICES
SO LOW EVEN OUR COMPETITORS GASP!

In stock now test equipment, microprocessors, teletypes, transformers, power supplies, scopes, sig. gen's, motors, peripheral equipment, I.C.'s, tools, components, variacs, keyboards, transistors, microswitches, V.D.U's sub-assemblies + thousands of other stock lines. Just a mere fraction of our vast range, is displayed below. 100's of bargains for callers.

TELETYPE ASR33 I/O TERMINALS

£235 + CAR + VAT

Fully fledged industry standard ASR33 data terminal. Many features including: ASCII keyboard and printer for data I/O, auto data detect circuitry, RS232 serial interface, 110 baud, 8 bit paper tape punch and ready for off line data preparation and ridiculously cheap and reliable data storage. Supplied in good condition and in working order. Options: Floor stand **£12.50 + VAT**
Sound proof enclosure **£25.00 + VAT**

ICL TERMIPRINTER 300 BAUD TERMINALS

£325 + CAR + VAT

Made under licence from the world famous GE Co. The ICL Termiprinter is a small attractive unit with so many features it is impossible to list them in the space available! Brief spec. as follows; RS232 serial interface, switchable baud rates 110, 150, 300, (30 cps), upper and lower case correspondence type face, standard paper, almost silent running, form feed, electronic tab settings, suited for word processor applications plus many more features. Supplied in good condition and in working order. Limited quantity

MAKE YOUR COMPUTER TALK!!!

VIA OUR EX-GPO MODEM UNITS

Well, not exactly talk, but communicate over a standard dial-up G.P.O. line with any other modem. The modem unit 2A is housed in an attractive fibre glass case measuring only 15"w x 13"d x 5"h, inside are the electronics and mains power supply which enable serial duplex data communication between terminal/computer etc. at any speed up to and in excess of 250 baud (300 at a push). Made to the most stringent, exacting specification for the G.P.O. These units feature Modular plug in P.C.B.'s, internal test points, Standard tone frequencies, Configureable to terminal or computer end, Auto unattended answer, RS232/V24 interface on standard 25 way 'D' socket, etc. etc., supplied complete with diags., at a fraction of their original cost at only **£55.00** + £4.50 CARR.

NOTE. Units believed working, but untested, unguaranteed. Permission may be required for connection to G.P.O. lines.

EX STOCK

SOFTY

SOFTWARE DEVELOPMENT SYSTEM, INVALUABLE TOOL FOR DESIGNERS, HOBBYISTS ETC.
Enables "open heart surgery" on 2708, 2716, etc, Blows, Copies, Reads EPROMS or emulates EPROM/ROM IN-SITU whilst displaying contents off ROM/RAM on a domestic TV receiver. A host of other features.
Write or phone for more details.

£115 + VAT & CARR

You'll never regret buying a SOFTY!

THE CHIPS ARE DOWN
MOSTEK, INTEL, NEC, MOTOROLA I.C. PRICES SLASHED!

A massive purchase of brand new "state of the art" data processing equipment enables us to offer the following chips at never, and we mean **never** to be repeated prices.

8085A	Central Processor	£11.99
8155C	256x8 Static Ram	£8.95
8253C	Programmable Interval Timer	£8.95
8255A	Programmable Peripheral Interface	£9.95
8259A-8	Programmable Interrupt Control	£4.75
8755A	2Kx8 Eprom 16 I/O Lines	£34.50
MC6850P	ACAI	£3.75
2652	MPCC Comms. Controller	£24.00
2102 1K	Static 650ns Rams 8 for	£5.25
1702	256x8 Eprom	£3.75
5101L-1	256x4 Static Ram 450ns	£4.95

And Remember All Chip Prices *Include* V.A.T.

All above I.Cs are brand new or removed from new unused sockets P.C.B's. Eproms supplied washed.

All full spec. and guaranteed

★ RAM AND EPROM STAR OFFERS ★

2716 Single 5v rail EPROMS	£10.25
2716 Three rail EPROMS	£ 8.50
2708 EPROMS	£ 4.95
4116 16k x 1 200 n s RAMS 8 for	£28.50

SUPERVALUE P.C.B. SPECIAL

Another great buy. Board contents include 62 Digital I.C.'s all located in 14 pin D.I.L. sockets. Original cost over **£90**, our price only **£4.95 + pp 65p**

32K x 8 DYNAMIC/STATIC RAM CARDS

A masterpiece of electronic engineering and our own advantageous buying enables us to bring you a complete memory system at a give-away price. Originally made for a large processor the RAM card has many features, including on board refresh, internal parity generation and checking. Standard TTL inputs/outputs, +5, +12, −15v supply rails and its effective STATIC capability make it useable with many CPU's. A fast cycle time of approximately 400ns make this a snip at only **£90.00 + £3p & p.** Supplied complete with circuits.

5v D.C. POWER SUPPLIES

Following the recent "SELL OUT" demand for our 5v 3 amp P.S.U. we have managed to secure a large quantity of ex-computer systems P.S.U.'s with the following spec.; 240 or 110v A.C. input. Outputs of 5v @ 3-4 amps, 7.2v @ 3 amps and 6.5v @ 1 amp. The 5v and 7.2v outputs are fully regulated and adjustable with variable current limiting on the 5v supply. Unit is self contained on a P.C.B. measuring only 12" x 5" x 3". The 7.2v output is ideal for feeding "on board" regulators or a further 3 amp LM323K regulator to give an effective 5v @ 7 amp supply.
Supplied complete with circuit at only **£10.95 + £1.75pp.** Believed working but untested, unguaranteed.

DISPLAY I.C. AND TRANSISTOR BARGAINS NEVER CHEAPER

All I.C.'s and Transistors by well known manufacturers and fully guaranteed. No fall outs. Comprehensive data on I.C.'s 15p per type.
2N4351 N channel MOS FET
2N4352 P channel MOS FET
60p each £1.00 per pair
HIGH VOLTAGE NPN POWER SWITCHING transistors BVcbo 600v BVceo 500v BVebo 15v 1c 5 amps Pc 125 watts HFE 60 typ ft 2.5 mhz ideal invertors, etc. TO3 £1.60 each 4 for £5.40
BF258 NPN 250v @ 200ma 45p each 3 for £1.08
I.R. BSB01 2.5 amp 100v bridge rec P.C. mount long leads 35p each 4 for £1.08
IN4998 4 amp 100v P.C. mount diodes long leads 14p each 10 for £1.10
LM309K + 5v 1.2 amp regulator £1.10 each 6 for £5.35
AGFA C10 computer grade cassettes complete with library cases 68p each, 10 for £5.50
IN4004 SD4 1 amp 400v diodes 7p each 18 for £1.00
I.R. 12 amp BRIDGE RECS. 400 volt £1.25 each

POWER DARLINGTON SCOOP!
MJ1000 NPN 60v 90w 8 amps TO3 95p each
2N6385 NPN 80v 100w 10 amps TO3 £1.25 each
MJ4030 NPN 60v 150w 16 amps TO3 £2.25 each

S.C.R.'s
2N3001 30v 350 ma TO18 22p each 6 for £1.00
2N5061 60v 800ma TO18 27p each 4 for £1.00
2N4441 50v 8 amps TO220 45p each 10 for £4.00
C106D1 400v 5 amps TO202 55p each 10 for £5.00

TRIACS
G.E. 12 amp 600v TO220AB 95p each 10 for £8.75
A.E.I. 10 amp 400v ready mounted on 2½ x 2½ heatsink £1.00 each 4 for £3.75

LOW PROFILE I.C. SOCKETS
8 D.I.L. 10p each 12 for £1.00
14 D.I.L. 14p each 8 for £1.00
16 D.I.L. Gold Plated mil. grade 22p each 6 for £1.00
22 D.I.L. 27p each 5 for £1.00
24 D.I.L. 35p each 3 for £1.00
40 D.I.L. 60p each 2 for £1.00

OTHER GOODIES
2N3055 I.R.C.A.I. 65p each
2N5843 R.F. output, 40 volts, 1 watt up to 1000MHZ TO5 55p each 10 for £5.00
2N4304 WN720 F.E.T. transistor 37p each 3 for £1.00
LM380N/SL6051 14 D.I.L. 2 watt A.F. amp 80p each 8 for £6.00
CA3028B DC-120 MHZ differential cascode amp £1.00 each 3 for £2.50
CA3011 20 MHZ wideband amp TO99 case 65p each 2 for £1.00
TMS3114 DUAL MOS 128 bit static shift reg. DC-2.5 MHZ £1.50 each 4 for £4.25
NE555 27p each, 10 for £2.50
GE424 zero voltage switch, triac SCR relay driver TO5 can £1.10 each 7 for £6.50
LM384 5 Watt audio I.C.s £1.50 each 10 for £11.00
FPQ3725 4 NPN 50v 500ma transistors in 14 D.I.L. pack 70p each 2 for £1.00

KEYBOARDS

★ LOW PRICE CHASSIS ★

A special bulk purchase enables us to offer the above keyboard at a lowest ever price. 49 coded keys encoded into a direct TTL compatible 7 bit output. Features such as delayed strobe, 5 volt D.C. single rail operation and rollover protection make this an absolute must for the MPU constructor! Supplied complete with connection diagram and edge connector at a secondhand "no time to test" price of only **£20.00** + P.P. £1.60

SUPER CASED VERSION Same as above spec. but housed in attractive two tone moulded, free standing case. Unit also includes an all TTL parallel to serial convertor (no details) etc.

£27.50 + P.P. £1.85

SEMICONDUCTOR 'GRAB BAGS'

Amazing value mixed semiconductors, include transistors, digital, linear I.C.'s, triacs, diodes, bridge recs. etc. etc. All devices guaranteed brand new, full spec. with manufacturers markings, fully guaranteed
50 + BAG £2.95 100 + BAGS £5.15

MUFFIN FANS

Keep your equipment Cool and Reliable with our tested ex-equipment 'Muffin Fans' almost silent running and easily mounted. Available in two voltages. **110 V.A.C. £5.05 + pp 65p OR 240v A.C. £6.15 + pp 65p. DIMENSIONS** 4½" x 4½" x 1½".

ELECTRONIC COMPONENTS & EQUIPMENT — 66% DISCOUNT

Due to our massive bulk purchasing programme which enables us to bring you the best possible bargains, we have thousands of I.C.'s, Transistors, Relays, Cap's., P.C.B.'s, Sub-assemblies, Switches, etc. etc. surplus to our requirements. Because we don't have sufficient stocks of any one item to include in our ads., we are packing all these items into the "**BARGAIN PARCEL OF A LIFETIME**" Thousands of components at giveaway prices! Guaranteed to be worth at least *3 times* what you pay plus we always include something from our ads for unbeatable value!! Sold by weight.

2.5kls £ 4.75 + pp £1.25 **5kls £ 6.75 + pp £1.80**
10kls £11.75 + pp £2.25 **20 kls £19.99 + pp £4.75**

★ SHUGART SA801 ★

8" Floppy Disk Drives
New and boxed £225.00 + VAT

BARGAINS GALORE!

In our walk round Warehouse
NOW open Monday to Saturday 9.30-5.30

TOROIDAL TRANSFORMERS

PR 240v pri. sec. 15-0-15 @ 2 amps dimensions 3" x 2½" £4.95 + p.p. 99p
TM 240v 110v pri. sec. 15-0-15 8vA dimensions 2½" x 1" £1.95 + p.p. 30p
All voltages measured off load.

Plugs, Sockets & Connectors Cannon 'D' Range

Ways	Plug	Socket
9	£1.03	£1.26
15	£1.17	£2.01
25	£1.72	£2.58
37	£2.35	£4.14
50	£2.90	£5.46

25 way ex-equip. plug or socket £1.25

Edge connectors, gold plated

0.1 DS	40 way	£2.45
0.1 DS	85 way	£3.99
0.15 DS	56 way	£3.25
0.156DS	36 way	£2.00

All connectors easily cut to size
1000's of other connectors ex stock

CRICKLEWOOD ELECTRONICS

Dept. CT. 64-66 Melfort Rd., Thornton Heath, Croydon, Surrey. Tel: 01-689 7702 or 01-689 6800

MAIL ORDER INFORMATION

Unless otherwise stated all prices inclusive of VAT. Cash with order. Minimum order value £2.00. Prices and Postage quoted for UK only. Where post and packing not indicated please add 40p per order. Bona Fide account orders minimum £10.00. Export and trade enquiries welcome. Orders despatched same day where possible. Access and Barclaycard Visa welcome.

S.R. Collins

How to use your screen memory for purposes other than display and improve your memory at the same time.

Many people own microprocessors that accommodate only a small amount of user RAM: There's less than 1K in my unmodified NASCOM 1 for instance. It can be frustrating, even infuriating, when a program needs just 20 or 30 bytes more than is available.

But NASCOM owners, although all may not realise it, have access to the VDU RAM. If this — or even only a small section of it — is not needed for VDU display it can be conscripted for other purposes. The acquisition of this extra RAM costs not a penny!

Swings And Roundabouts

There's a catch, however. What we gain on the horses . . . For the VDU RAM is scrolled up during or after all the commands and during the Read (R) and Write (W) commands it can be scrolled up several times. So although you may enter an instruction in the correct address it will be scrolled up out of that location for sure, and often you won't know where on earth it's landed up. A string of program instructions is useless if you don't know its start address.

Therefore VDU RAM cannot be used until all danger of scrolling has passed: until, in other words, you have entered the Execute (E) command and the program is running.

"What use is that?", you may ask. "How can I use the VDU RAM if I can't get at it until the program's started?". A good question.

The answer is that almost every program needs storage space for some of its data or operations. Often, it needs great gobbets. And almost always these stores have to be initialised (even if only cleared) after Execution. These are the fields you can exile to the VDU RAM.

I evolved this method of utilising the VDU RAM when, in order to test a 'guaranteed' Roulette system, I needed 240 bytes of data storage and could spare only 40 of the User RAM. Determination to test this money-making system at any price (except that of buying extra RAM!) led me to raid the VDU RAM.

And, provided you remember that nothing can go on the screen that is not put there by the main program, you can also go to it and put those acres of RAM, which would otherwise lie fallow, to work.

Mapping It Out

You will need to know exactly which section of this RAM you can use. Therefore you need an accurate memory map of the VDU. The details are given in Fig.1. This grid maps the screen's 768 locations (16 lines of 48). Each location can accommodate one byte. This is not surprising since each location is an actual byte of RAM. It is therefore addressed in the same way as your other RAM.

Addresses are always entered low byte first in Z80 instructions and the grid is designed so this comes naturally. Decide first which location you wish to load and note its letter or figure. Suppose we wanted to load the location represented by the second '5' along line eight. We move to the left along the same line until we encounter a letter or figure in the upper position. This is 'A' in our example, and gives us the lower half of the address: 'A5'. The higher half is found, again in the upper position, right at the left of the same line — '09' in this case. Therefore the full address of our chosen location, and low byte first, ready for loading, is 'A5 09'.

Let's put the letter 'E' in that location:

```
0C50   3E 1E
0C52   CD 3B 01   ] Clear screen
0C55   21 A5 09     Load screen address (byte-about)
                    in HL
0C58   3E 45        Load ASCII code for 'E' in A
0C5A   77           Load contents of A into address
                    indicated by HL
0C5B   CF           End
```

This rudimentary routine can help you find your way around the screen. Pick out other locations and enter them at 0C56 and 0C57, peppering the screen with E's until you are confident you can pinpoint each and every location without hesitation.

Ignore the top line for the time being as it's a special case. It's also a good idea to ignore the bottom line and the extreme left column too since these are often not clearly visible when using a domestic TV as a VDU. And don't attempt to use any location not on the grid. There are, indeed, a further 16 bytes hidden between each line — you'll notice that line two stops at '08 39' but line three doesn't begin until '08 4A'. But don't be tempted to mine these buried treasures. There's something very odd goes on down those margins!

Showing Off

Now an illustration, albeit a minor one, of the technique. The following program operates that Roulette staking system I mentioned by loading a 40 byte string beginning at '0A 4D' on the screen. On execution, the first four locations are loaded with 1, 2, 3 and 4 and the remainder cleared. Thereafter, each time we press 'W' the last number is incremented and added to the string until this is full and holding the numbers 1 to 40. Pressing 'W' denotes a Win: for simplicity's sake I've omitted what happens when we lose — a pity we can't in real Roulette.

```
0C50   3E 1E
0C52   CD 3B 01      ] Clear Screen
0C55   21 4D 0A        LD HL,0A4D
0C58   06 04           LD B,04D
0C5A   3E 01           LD A,01D
0C5C   77          LP1 LD (HL),A
0C5D   23              INC HL
0C5E   3C              INC A
0C5F   10 FB           DJNZ, LP1
0C61   F5              PUSH AF
0C62   06 24           LD B,36D
```

RAM FOR FREE

1	OB	C					D																E																F									
	CA	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9
2	08	0					1																2																3									
	0A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9
3	08	4					5																6																7									
	4A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9
4	08	8					9																A																B									
	8A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9
5	08	C					D																E																F									
	CA	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9
6	09	0					1																2																3									
	0A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9
7	09	4					5																6																7									
	4A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9
8	09	8					9																A																B									
	8A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9
9	09	C					D																E																F									
	CA	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9
10	0A	0					1																2																3									
	0A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9
11	0A	4					5																6																7									
	4A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9
12	0A	8					9																A																B									
	8A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9
13	0A	C					D																E																F									
	CA	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9
14	OB	0					1																2																3									
	0A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9
15	OB	4					5																6																7									
	4A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9
16	OB	8					9																A																B									
	8A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9

Fig.1. The full screen memory address map for the NASCOM system.

```
0C64   36  00       LP2  LD (HL),00
0C66   23                INC HL
0C67   10  FB            DJNZ, LP2
0C69   06  24            LD B,36D
0C6B   21  51  0A        LD HL,0A51
0C6E   CD  3E  00   KBD  CALL KBD
0C71   FE  57            CP 57
0C73   28  02            JR Z,WIN
0C75   18  F7            JR,KBD
0C77   F1           WIN  POP AF
0C78   77                LD (HL),A
0C79   23                INC HL
0C7A   3C                INC A
0C7B   F5                PUSH AF
0C7C   10  F0            DJNZ,KBD
0C7E   CF                END
```

Note that for use with monitors other than T4 the CF instruction will need to be replaced with the appropriate monitor call.

Load the program and execute from C50, but don't start pressing 'W' yet. Two things are immediately apparent. The last 36 screen locations should be filled with zeros. On the screen these appear as "◻" and that sure enough suggests zero. However the first four locations are " ┌⊥ ┘≷ ". These are the ASCII code's representation of '01, 02, 03, 04'. What appears in each location on the screen is the ASCII interpretation of the actual content of the corresponding byte of VDU RAM.

You are no doubt familiar with the ASCII code but we need to take a close look at the NASCOM version, so it is given in Fig.2.

The table is referenced just like a map. The 'MSB' (Most Significant, or first, Bit) is found from the vertical column on the immediate left and the 'LSB' (Least Significant, or second, Bit) from the line along the top. The £ sign's reference is consequently 23Hex. If any VDU RAM byte contained 23H then '£' would appear on the screen in that byte's location.

Now begin pressing 'W' slowly and follow from the chart the successive ASCII symbols as they appear. They will begin at "┌" (01H) and end with "⊏" (28H).

The NASCOM 1 microcomputer system.

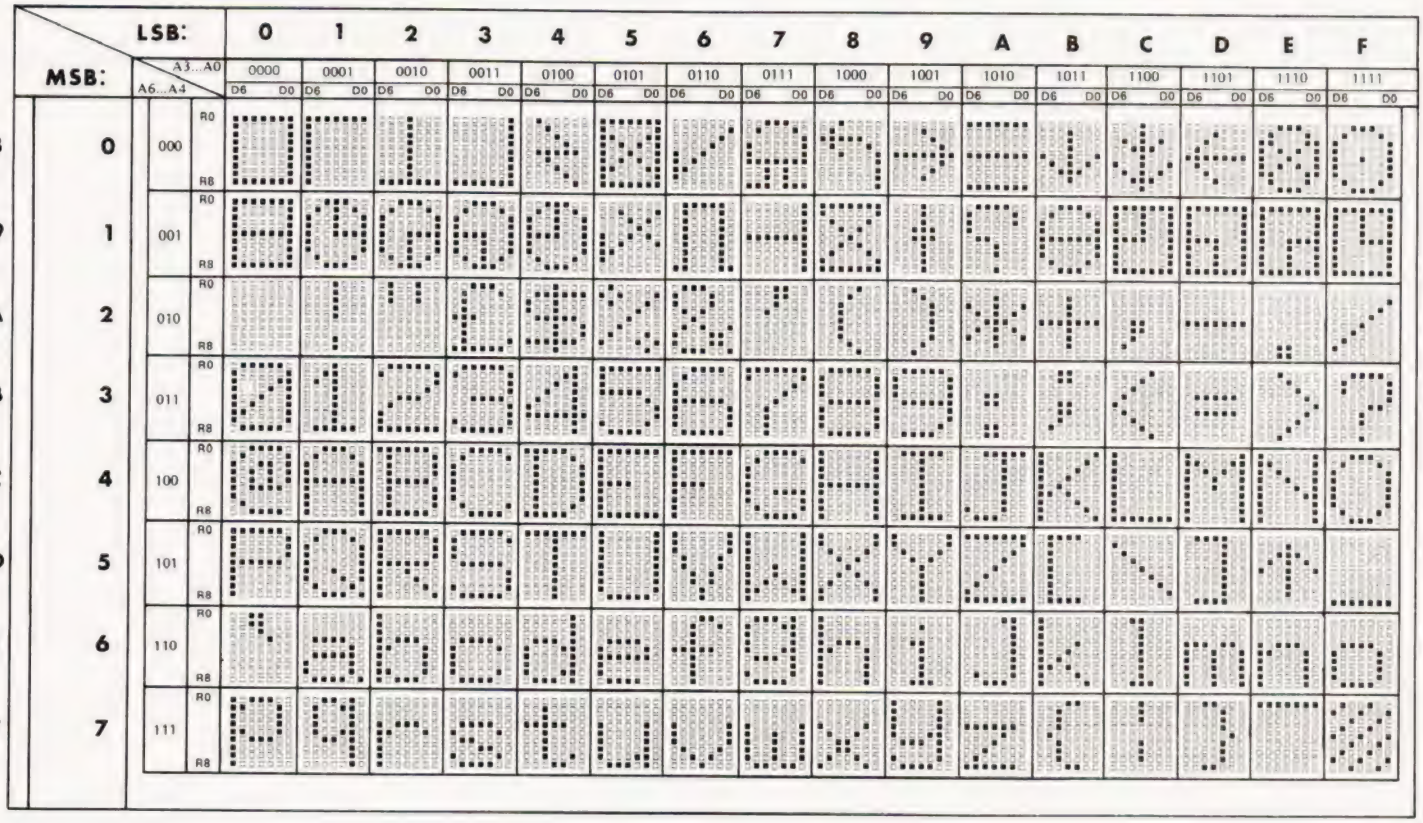


Fig.2. The NASCOM alphagraphic character set in display matrix format.

These numbers are all in Hex so if you wish to interpret ASCII symbols on the screen a double conversion is necessary: first from ASCII to Hex and then from Hex to Decimal. There is even a further complication. The ASCII code ends at '7FH'. What would happen if we loaded a byte of VDU RAM with '80H'. Well, after '7F' the NASCOM 1 makes the ASCII code revert to zero and carry on again from there. "□" could therefore represent either '00H' or '80H' and "<" either '30H' or 'B0H' and so on. This is the reason for the far left column.

You can nevertheless rest assured that it is only the screen that is confused. If the relevant VDU RAM is correctly loaded with '80H' then '80H' is without a shadow of doubt what is actually sitting in that byte, even though the screen suggests '00H'.

But don't lose heart. Remember, you wouldn't even be given the chance to interpret if you were employing totally invisible User RAM. And you will need to carry out these interpretations only rarely and then of only a few locations.

Additional Benefits

Nevertheless I have covered interpretation and its possible pitfalls since the ability to do this quickly when required bestows two important benefits.

The first is when debugging. I could tell immediately on execution whether the given program was correct. It wasn't at first — is any program, ever? I wrote 0C78-7A as '3C 77 23' originally, so the number '5' was omitted when pressing 'W'. Because my data storage was on the screen, and I could interpret it, I was able to spot this without conventional debugging. If you do need to debug remember that the Single Step (S) command cannot be used because of the scrolling it imposes. Instead, use the Breakpoint (B) command to leapfrog you successively beyond each instruction that uses or modifies the VDU RAM.

The second advantage is that having the data stores already on the screen, even though in ASCII, often obviates the need to display some of them in their normal form. In my Roulette program, if I needed to know when the Roulette Wheel coughed up zero, I merely watched the screen location where the Roulette numbers were stored and awaited "□". Similarly, it was convenient to be able to check at each throw whether I'd just won or lost. I stored a win as '01' (┌) and a loss as '02' (┴). These were easily recognisable in the data stores, so saving me the chore of translating these to 'WIN' and 'LOSS' and including them in the display in that form.

Finally we'll have a look at that top line which I've said is a special case. It's special because it isn't subject to scrolling. Therefore it can be used for active program segments and not just data storage. You can use more than the line on the screen for you'll notice that, although it's the top line, it actually follows the last line in memory — and you can use locations 0BBB to 0BFF.

Once again there's a slight snag. This time, although we dodge the scrolling prohibition, we can't — for obvious reasons — 'Clear Screen', either in a program or by pressing RESET. If a program calls for the screen to be cleared you must do it by scrolling up before execution. But there's a way around RESET. Tape your top line first, separately. Then, if you have to press RESET you need only reload this tiny slice of memory and you're away again.

The entire screen is hardly ever needed for display. When it isn't I now automatically put my data storage there, even when I have space for it in User RAM. For, once the technique has been acquired, it is often useful — and always fascinating — to have the data storage's heart, lungs and bowels surgically exposed on the screen and watch them working.

FREE — ADVICE/DEMO/COFFEE

PET NEW KEYBOARD	from £399.00 + £59.85VAT	£458.85
COMPUKIT UK101 KIT	£199.00 + £29.85VAT	£228.85
UK 101 BUILT	£249.00 + £37.35VAT	£286.35
SUPERBOARD II	£156.52 + £23.48VAT	£180.00
STYLISH CASE—UK101/S.Board	£29.39 + £4.41VAT	£33.80
TRS 80 16K LEVEL II	£356.00 + £53.40VAT	£409.40
5¼ DISC DRIVE for TRS80	£236.00 + £39.40VAT	£271.40
H 14 LINE PRINTER KIT	£356.00 + £53.48VAT	£410.00
BUILT	£510.00 + £76.50VAT	£586.50
EXIDY SORCERER 16/32/48K	from £749 + £112.35VAT	£861.35
RENUMBER PROGRAM 101		£4.00 inc.
GRAPHIC AID FOR 101		£4.00 inc.
GRAPHIC AID FOR TRS80		£5.50 inc.
ONE-ARM BANDIT TRS80		£7.00 inc.

N.I.C.
61 Broad Lane, London N15 4DJ
Day 01-808 0377 Ev. 01-889 9736

SAE Enquiries
BARCLAYCARD VISA

ANALOG TO DIGITAL CONVERTER
COMPLETE KIT + P+P **£82·00**

16 CHANNEL • 60 µS • 8 BIT • 64 DIN • EUROCARD

IS PLUG COMPATIBLE WITH ANY BUS USING A 64 WAY INDIRECT CONNECTOR SUCH AS THE ACORN: MICROTAN 65; TRITON; SC/MP AND OTHERS. COMPLETE KIT INCLUDES ALL IC'S SOCKETS DIL SWITCHES & 64 DIN CONNECTOR CIRCUIT DIAGRAM, CONSTRUCTIONAL DETAILS, SAMPLE PROGRAMS IN 6502 ASSEMBLER, BASIC AND SOME SOLDER. INTERFACE WITH ANY MICROPROCESSOR. CONVERSION TIME PER CHANNEL LESS THAN 60 MICROSECONDS. TOTAL UNADJUSTED ERROR + / – ½ LSB. 256 LEVELS RESOLUTION. INPUT RANGE 0 TO 5.12 VOLTS. SAMPLE & HOLD. 1 MEG INPUT IMPEDANCE. FULLY DECODED TO ANY 16 LOCATIONS IN 64K, ADDRESS BUS CONTROLS CHANNEL SELECTION. 8 BIT DATA BUS. ONE LP TTL LOAD ON BUS. SINGLE 5 VOLT SUPPLY @ 250 mA + 12 V ON BOARD. 100mm x 160mm PCB. LOW NOISE OP AMP AVAILABLE FOR X10 OR INTERUPT DRIVE OR USER OPTION. AVAILABLE SEPARATELY 34 WAY PCB SOCKET £3.00, 34 WAY PLUG & 3 FT. RIBBON CABLE £8.00. 64 WAY SOCKET £3.00, 3U FRONT PANEL & HW £4.00. ASSEMBLED & TESTED WITH CONNECTORS & FRONT PANEL £110.00. INC P&P. ALLOW 21 DAYS DELIVERY. 50p P&P ON SEPS. SEND SAE FOR DETAILS

STONEAGE ELECTRONICS
THE COTTAGE 70 ALBION DRIVE LONDON E8 4LX Tel 01 254 4727

MaricK **UK 101**

★ Programmable Sound Generator ★

Enter the exciting world of sound using the superior sound chip AY-3-8910. Imagine those whistling bombs falling from the sky, the sound of a laser striking the Aliens, a steam train passing by, the range of sounds is quite tremendous. We supply the P.C.B., 15-page manual describing the Hardware, Software and construction details, and a tape containing a game with sound and a program to help you explore the vast range of sounds that you can program, all for only £9.50

★ UK 101 Software on Tape ★

8K Home Finance
4K Alien Invaders
8K Asteroid Runner
4K Snakes and Ladders
4K Drawing Machine
4K Fruit Machine
4K The My-mY Game

And our Latest and Greatest – 5K Space Defender: one step beyond Alien Invaders – Beware of the Kamakaze Alien! £3.00 each or £2.50 each for any two or more. SAE for details.
Cheques or P.O. to MaricK Dept. 11, 1 Branksome Close, Paignton, Devon TQ3 1EA

★ SPECIAL OFFER ★ All eight programs for only £17.50

ASCII KEYBOARD £39.00 inc VAT, P&P
Brand new, end of line, type KB060. Designed for ease and accuracy of use with 60 keys arranged in stepped rows, auto repeat, 2-key rollover. UC and LC ASCII coded. S.a.e. for details.

THE ZX80 MAGIC BOOK £4.95
Edition 2 containing 15 plus programs including Music, Hammurabi, Animals and Othello. Programming tips. Using USR. Hardware notes.

23 + 23 WAY ZX80 EDGE CONNECTOR £3.00

MICROPROCESSOR POWER SUPPLY £29.30
Type PZ100. Cased. 240VAC input. Stabilised outputs +5V @ 1A, + 12V @ 300mA, – 12V @ 50mA. Assembled and tested.

ALL PRICES INCLUDE UK DELIVERY & 15% VAT

TIMEDATA Ltd.
57 Swallowdale, Basildon, Essex

AERCO
EST. 1945
GEMSOFT
Computer Services

Appointed dealers for APPLE, SUPERBRAIN, VIDEO-GENIE.

As well as supplying the Micro Systems above, we specialise in writing Software for those special applications for which you cannot buy a package, such as Special Stock controls, Invoicing systems, Production control and planning, Engineering, etc. (Our current projects include systems for Hire-Purchase accounts control, Stock Control for Hi-Fi retailers, Re-order scheduling, and a data-logging system.)

So, whether you require a Micro-Computer at a competitive price. . . supported with some intelligent advice, or a system with standard or special software,

Contact:

Aerco-Gemsoft Computer Services,
27, Chobham Road,
Woking,
Surrey GU21 1JD
Telephone: Woking (04862) 22881

Video Genie — £330 + VAT (379.50 inclusive)

Conquer the Computer

Learn to really understand the Computer. How it works and operates.
Its 'language'.
How to program it and make full use of its capabilities.

- No previous knowledge necessary.
- Special educational Mini-Computer supplied ready for use.
- Complete home study library.
- Self-test program exercises.
- Complete programming instructions using computer.
- Services of skilled tutor available.

Please send details without obligation to:–

Name .....
Address .....
.....
.....

CT/11/814 BLOCK CAPS PLEASE

BRITISH NATIONAL RADIO & ELECTRONICS SCHOOL
4 Cleveland Road, St.Helier, Jersey, Channel Islands.

Trevor Lusty

How to use permutations to disentangle other people's programs, and avoid being listed as missing.

You know, one thing you can say about computers is that they're patient. After all, my PET's just waited ten minutes for me to think up a witty comment with which to start this article. Oh well — — let's hope you had more luck with this month's problem.

Getting Started

Programming in reverse is not as easy as it seems, is it? There are, however, a few things which you can try:-

1) List all the variables in the program and try to identify their functions.
2) Run the program and stop it at some known point. Then dump the variable values.
3) Try to draw a flowchart of the program.
4) Dry run the program with pencil and paper, keeping a careful note of changes to any of the variables.

If instead of printing the first set of permutations, we stop the program and dump the contents of array P, we obtain the following table:-

```
0 1 2 3 4 5 6 7
0 0 1 2 3 4 5 6
0 0 0 1 2 3 4 5
0 0 0 0 1 2 3 4
0 0 0 0 0 1 2 3
0 0 0 0 0 0 1 2
0 0 0 0 0 0 0 1
0 0 0 0 0 0 0 0
```

Note that P(0,0) is in the top left-hand corner and P(7,7) is at the bottom right of the table. We can also deduce that the first set of permutations is in the right-hand column, and that a large part of the matrix is unused. For clarity, I shall omit this unused portion of array P. A dry run of the program shows that the following movements occur before the next set of permutations is printed.

```
0   1   2   3   4   5   6 → 6
    0   1   2   3   4   5 → 7 ← M
        0   1   2   3   4 → 5
            0   1   2   3 → 4
                0   1   2 → 3
                    0   1 → 2
                        0 → 1
                            0
```

M holds the number of the current column and I(M) points to the position of the column value within a column. The process is a recursive one. The permutations of the digits 0 to 7 are found by stepping 7 through the permutations of the digits 0 to 6, and the permutations of the digits 0 to 6 are found by stepping 6 through the permutations of the digits 0 to 5, etc. etc.

The flowchart for the process is shown in Fig.1, and Fig.2 gives a BASIC program which demonstrates dynamically how the values move within array P. Note that 'down' is used with reference to this layout, the second subscript actually increases as we move down the screen.

Improving The Solution

If you look at the diagram above you will note that many of the values are copied unnecessarily. When moving the column value through the permutations in the previous column it is only necessary to interchange two values. Having changed a value within a column, however, subsequent columns must be reset. The following diagram shows how the first change in the 0 to 5 column is accomplished:-

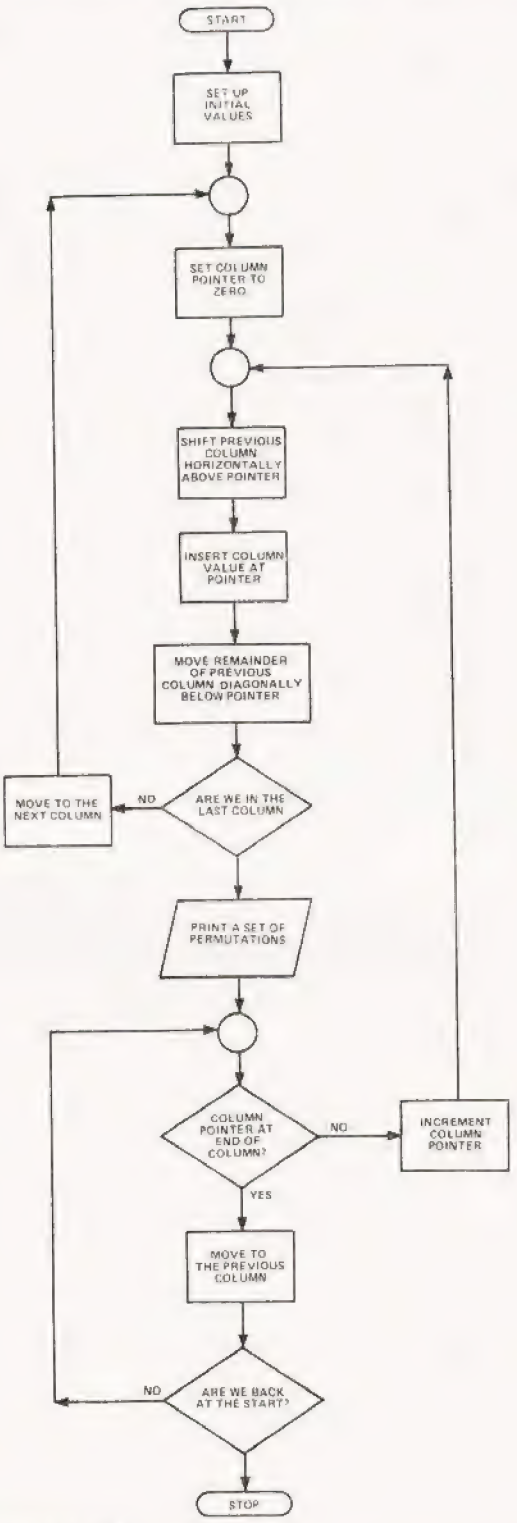


Fig.1. How to do it badly.

```
0   1   2   3   4 → 4   6 ← M 7 ← M
    0   1   2   3   5 ← M 4   6
        0   1   2   3   4   5
            0   1   2   3   4
                0   1   2   3
                    0   1   2
                        0   1
                            0
```

```
100 LET SP=32850
110 DIM P(8,8),I(8)
120 LET N=7: M=1: P(0,0)=0:PRINT "[CLS]"
130 POKE SP,48
140 I(M)=0
150 FOR J=0 TO I(M)-1
160 POKE SP+80*J+4*M,P(J,M-1)+48
170 P(J,M)=P(J,M-1)
180 NEXT J
190 POKE SP+80*I(M)+4*M,M+48
200 P(I(M),M)=M
210 FOR J=I(M)+1 TO M
220 IF J>M THEN 250
230 POKE SP+80*J+4*M,P(J-1,M-1)+48
240 P(J,M)=P(J-1,M-1)
250 NEXT J
260 IF M=N THEN 280
270 M=M+1:GOTO 140
280 IF I(M)=M THEN 300
290 I(M)=I(M)+1:GOTO 150
300 IF M=1 THEN 120
310 M=M-1:GOTO 280
320 END
```

Fig.2. Remember to change SP to suit your system.

The BASIC program (Fig.3) and flowchart (Fig.4) show how the above changes may be implemented. While the algorithm works, it is often not the most efficient when coded in a high level language.

```
200 LET SP=32850
210 DIM P(8,8),I(8)
220 LET N=7:M=0:P(0,0)=0:PRINT "[CLS]
230 POKE SP,48
239 REM **RESET THE COLUMNS
240 M=M+1
250 I(M)=0
260 POKE SP+4*M, M+48
270 P(0,M)=M
280 FOR J=1 TO M
290 S1=P(J-1,M-1)
300 POKE SP+80*J+4*M, S1+48
310 P(J,M)=S1
320 NEXT J
330 IF M<N THEN 240
339 REM **MOVING DOWN THE COLUMN
340 S1=I(M):I(M)=I(M)+1:S2=I(M)
350 POKE SP+80*S1+4*M, P(S1,M-1)+48
360 P(S1,M)= P(S1,M-1)
370 POKE SP+80*S2+4*M, M+48
380 P(S2,M)=M
390 IF M<N THEN 240
400 IF I(M)<M THEN 340
410 M=M-1
420 IF M>0 THEN 400
430 END
```

Fig.3. Longer but faster.

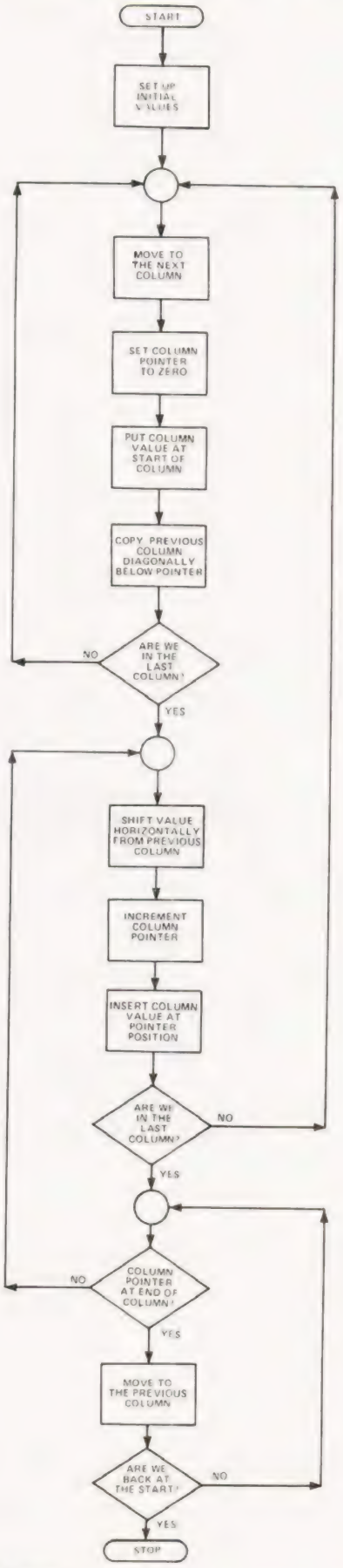
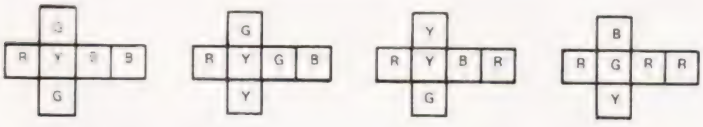


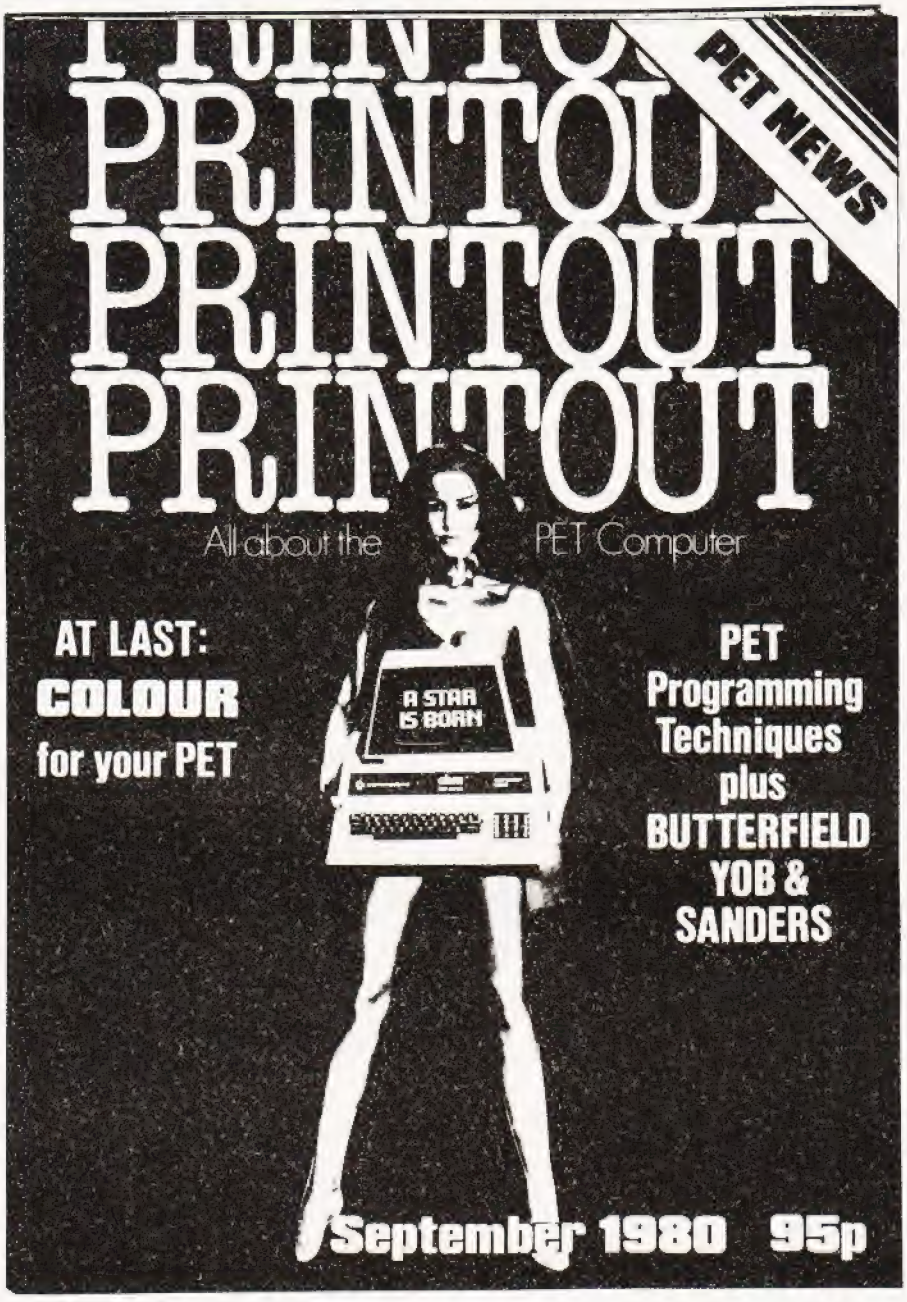
Fig.4. How to do it better.

Instant Insanity

Perhaps the title of this month's problem is a little off-putting, but I'm sure you won't be discouraged. The following diagram represents the faces of four cubes, the letters on each face indicating the colour. Y = yellow, B = blue, R = red and G = green. The problem is to stack the four cubes so that there is exactly one face of each colour on each side of the stack. Find an efficient computer solution.



PET SOFTWARE – a guide



PRINTOUT – the independant magazine that's all about the CBM/PET computer.

Ten times a year PRINTOUT brings you the latest news about PET peripherals and software, conducts extensive and unbiased reviews, and tells you how to get the best out of your computer. In it you will find programming hints and listings – a complete Mailing List program free of charge in the latest issue – plus several fascinating pages of readers letters. There is even a gossip column! If you are interested in PET, you must read PRINTOUT These are some of the features from the October issue:

:: Profiles of Superchip and the Petaid database program
:: 'What's wrong with WORDPRO', an evaluation of Commodore's word processor - and a guide to its use
::'Memory from the Buffers' – How to get more memory
::'Style & Technique' – How to write better PET programs
::'Personal Electronic Transactions' by Gregory Yob
::Tommy's Tips – programming problems solved here
::'Pets & Pieces' - our irrepressible columnist Gavin Sanders
plus News, Software Reviews, Letters , Gossip and Listings

PRINTOUT
PO Box 48, Newbury,
Berkshire, RG16 OBD
Telephone (0635)-201131

I enclose [ ] £9.50 for one year's subscription (UK) [ ] £10.50 for one year's subscription (Eire)
[ ] £14.50 for a year's subscription (overseas) [ ] 95p for a sample issue (UK & Eire only)

NAME ..... ADDRESS.....
.....POSTCODE.....

COMPUTERAMA

All we discount is the price!

Computers

Pet, 40 col, new ROMS green screen, large keyboard	8K	£399
	16K	£499
	32K	£599
Pet, 80 col, new DOS	32K	£840
	64K	POA
TRS-80 system, includes VDU, cassette recorder & P.S.U.	(16KLI	£420
	(16KLII	£475
TRS-80 CPU, includes UHF TV modulator & P.S.U.	(16KLI	£229
	(16KLII	£349
16 KL II with numeric keypad		£379
TRS-80 expansion interface	32K	£275
Apple II includes BASIC interpreter and UHF colour TV cards	16K	£599
	32K	£625
	48K	£649
Video Genie includes on-board cassette recorder, output to VDU or UHF TV (TRS-80 BASIC)	16K	£299
	32K	£325
	48K	£349
Video Genie expansion bus box	S100	£245

Dear Customer,

Our computer products are the best possible value for money. The price you pay is low because we import direct, and sell direct, thus cutting out the retailer. We look after you, our customer with a full year guarantee and after-guarantee servicing. We can give you unbiased advice and take orders with most credit cards over the telephone for despatch the same day. We also do personal financing and company leasing or lease-purchase. If you represent a public body or company we can also grant you a 30-day account. You can't get a better deal elsewhere – scan the pages of this magazine and see. Why not order from us now – you'll be glad you did, I promise you.

Alan Brook
Computerama

Discs

Pet compatible

Commodore Dual	£595
Computhink 400K	£595
Dual 800K	£695
1.6Mb	£1195

TRS-80 compatible, all with case & P.S.U.

Teac 40-track single	£199
Dual	£375
Quad	£725
77-track single	£295
Dual	£560
Quad	£1095

Shugart SA 400 Single	£195

Diskettes 5¼" double sided double density £30 for 10
8½" " " " " £35 for 10

Apple II compatible add on single drive £199

Printers

Electrosensitive Type

Quick Printer II (33 col) (TRS-80, serial & parallel inputs)	£125

Thermal Type

Phantom 400 (40 col)	£225
(with dot graphics) 800 (80 col)	£299

Impact Dot-Matrix

Commodore Tractor 80 col (for Pet) all Pet graphics	£395
Epson Tractor 80 col (for Pet) most Pet graphics	£299
Epson Tractor 80 col (for Pet) plus dot-graphics	£335
Anadex DP8000	£399
Anadex DP9500	£795
Dolphin BDP 80	£495
Paper Tiger with 5 char. sizes and dot-graphics	£495

Monitors: 12" _____ £69 12" (green screen) _____ £79

List of programmes available on request.

Interfaces

Pet to UHF TV	£25
Pet RS232 output	£65
" " in/out	£90
" " decoded output	£150
" " decoded in/out	£175
Pet multiplexer for networking up to 20 Pets	£350
Pet/S100, 4 slot	£112
Pet/Centronics	£45
" decoded	£69

Memory 16K RAM (4116) Apple, Pet, TRS-80, Sorcerer £27
4K Static RAM (2114) UK101, OSI £27

Cables

Pet/IEEE	£20
IEEE/IEEE	£25
RS232 Plug to socket	£25
RS232 Plug to plug	£25
For others please ring	

C12 **Blank Cassettes** 10 for £4 100 for £35

Paper

Electrosensitive for QPII	£3.50 per 2 roll pack
Thermal for Phantom 400, TCM 100	£3.50 per 2 roll pack
Phantom 800, TCM 200	£2.65 per roll
Impact, single part sprocket punched 9½ × 11 for Commodore, Epson, Anadex Dolphin & Paper Tiger, fanfold strippable	£9.50 per box 2000 sheets

TEL: BATH (0225) 333232

- Personal credit (same day)
- Company credit
- Full year guarantee
- After-sales service
- Mail order
- Export (most countries)

Please add £10 Securicor delivery on computers etc.
Plus 15 VAT on all prices

Computerama Ltd.
5 Cleveland Place East,
London Road, Bath, BA1 5DJ

COMPUTERS AUDIO RADIO MUSIC LOGIC TEST GEAR CB GAMES KITS

BREAD BOARD 80

COMPONENTS DEMONSTRATIONS SPECIAL OFFERS MAGAZINES BOOKS

It's all at Breadboard '80

This is **the** exhibition for the electronics enthusiast. From November 26 -30 there is only one place in the universe for the electronics enthusiast to be — Breadboard '80, at the Royal Horticultural Hall in London. The majority of leading companies will be exhibiting, including all the top monthly magazines in the field. There will be demonstrations on most stands and many feature special offers that are EXCLUSIVE to Breadboard!

All aspects of this fascinating field are catered for, from CB to home computing, so whether you want to buy a soldering iron or a synthesiser — or just keep up to date with your hobby — don't miss Breadboard '80.

With every order of FOUR or more advance tickets we will send you a FREE copy of E.T.I. 1999 (£1.50 normally)

AVOID QUEUES — GET ADVANCE TICKETS

Please send:

tickets @ £1.50

tickets @ £1.00 (Student/Child/OAP)

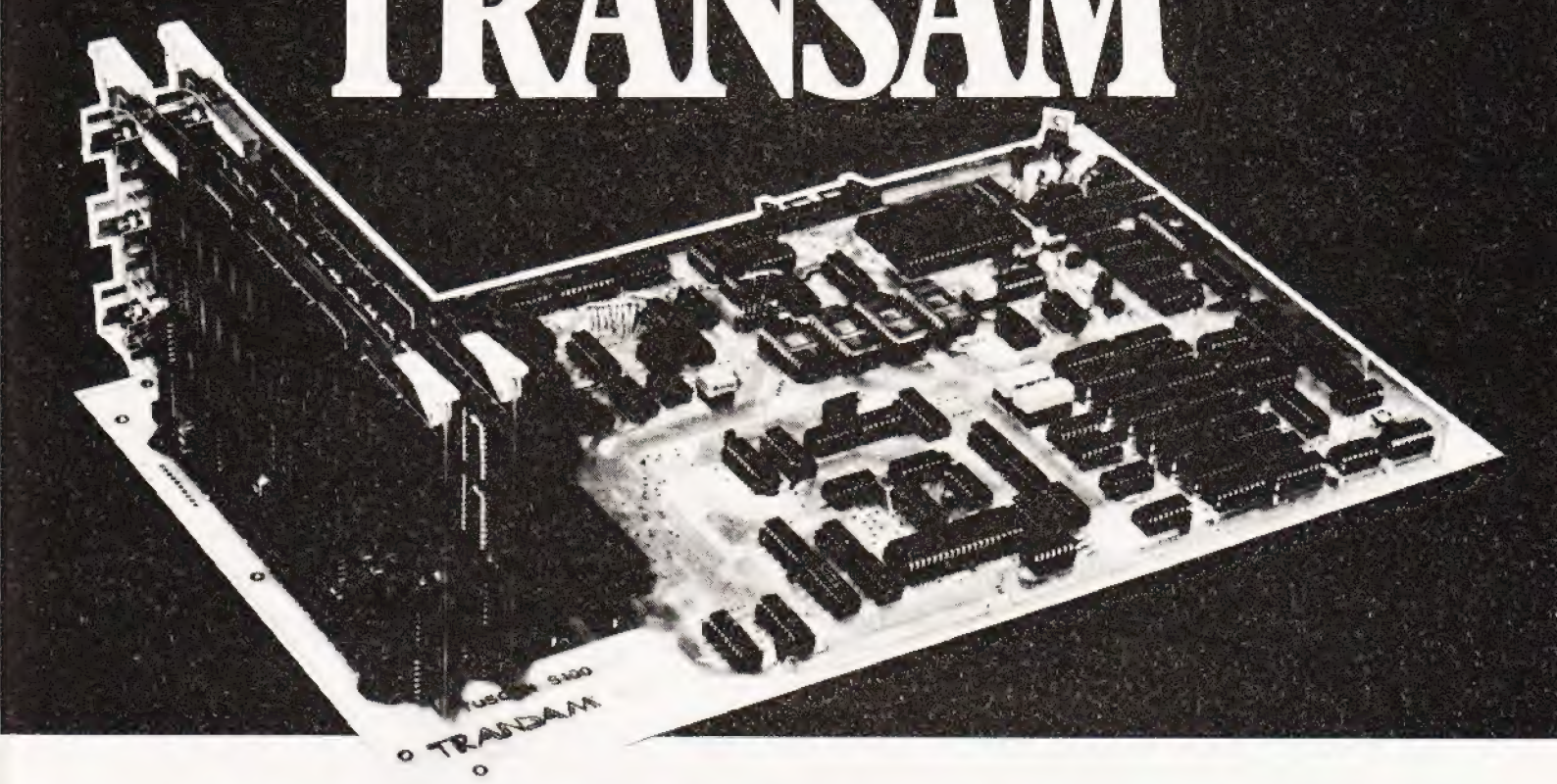
I enclose P.O./Cheque for £

TO:

Royal Horticultural Halls
Elverton Street
Westminster London SW1
November 26-30 1980

26th Nov — WEDNESDAY — 10am-6pm
27th Nov — THURSDAY — 10am-8pm
28th Nov — FRIDAY — 10am-6pm
29th Nov — SATURDAY — 10am-6pm
30th Nov — SUNDAY — 10am-4pm

'TUSCAN' FROM TRANSAM



Take a step up to your next Computer!

THE CONCEPT

How many ways are there to build an S100 system? Not many, and all expensive. TUSCAN changes all that.

Five S100 boards on one single board—just for starters. Plus five extra slots for future expansion.

What a combination! Z80 and S100 with the TRANSAM total package of system and applications software.

How do we do it? Our prices start at £195 and you can build up in easy stages to a fully CP/M compatible disc based system. Something to think about!

THE HARDWARE

The first Z80 single board computer with integral S100 expansion. British designed to the new IEEE (8 BIT) S100 specification, the TUSCAN offers total system flexibility. A flexibility available now.

The board holds the equivalent of a Z80 cpu card, 8k ram, 8k rom video and I/O cards with 5 spare S100 expansion slots and offers a price/performance ratio which is hard to beat.

Just compare our price with a commercial S100 ten slot motherboard with this specification.

THE SOFTWARE

TUSCAN offers the user the choice of system monitor, editor, resident 8k basic, resident Pascal compiler or full CP/M disk operating system. All options are upwards compatible and fully supported with applications software. Both 5¼" and 8" drives are supported in double density.

THE PACKAGE

TUSCAN is available in kit form or assembled. With several hardware and software options to suit your requirements and budget. Attractive desk top case also available holds 2 x 5¼" Drives.

TRANSAM

NOBODY DOES IT BETTER!

Send to
Transam Components Ltd., 59/61, Theobald's Road, London WC1

I am interested in the TUSCAN Z80 based single board computer with S100 expansion and enclose a S.A.E. for further details.

Name _____

Address _____

_____

Telephone _____

TRANSAM COMPONENTS LTD., 59/61, THEOBALD'S ROAD, LONDON WC1. TEL: 01-402-8137/405-5240. TELEX: 444198

CT's continuing comprehensive computerised coverage can refresh systems other mags can't reach!

Having come full circle with our series of guides to equipment, peripherals etc., we now return to the microcomputers themselves. In this month's guide we present an up-to-date listing of all the systems that are currently available in the UK. The layout is exactly the same as last time but, after many requests, we'll explain the cryptic code! Most of the entries are obvious but the memory and m/c notes appear to have been slightly mis-understood. The RAM entry is the amount of user RAM fitted in the machine as standard and the maximum that you can have, 1K/48K for example. In the case of single board computers the second entry is the size of the add-on memory board.

The m/c entry is even more cryptic, if the machine has direct machine code access through a monitor then the figure gives the size of this monitor, if the machine has a disc operating system then the name of this is given, CP/M for example.

Whilst every care is taken in the compilation of these guides it is not unusual to find that a new machine has been launched during the time it takes to print the magazine, or indeed that a manufacturer has upgraded his system. If you know of any systems that are not included please send the information, preferably in the format below, to the Buyers Guide Compiler at our usual address together with the prices and photographs if possible.

ACT Microcomputers

SYSTEM 800
Dist:- ACT (Computers), Radclyffe House
66-68 Hagley Rd, Edgbaston, Birmingham, B16 8PF
021-455 8686
+ growing regional network

CPU 6502 **I/O** RS232 PARA **BASIC** Yes **DISC** 2x5¼"
RAM 46K **CASS** N/A **Other** Various **m/c** MDOS
£3,950-8,950

Extras:- 8" disc, printers, modems
Applications:- Stand alone business system that can also run most PET software.

Acorn Computers

ATOM
Dist:- Acorn Computers
4A Market Hill
Cambridge
0223-312772

CPU 6502 **I/O** BUS PARA **BASIC** 8K **DISC**
RAM 2K/11K **CASS** Kansas **Other** FP option **m/c** YES
£125 kit, £150 built

Extras:- Colour graphics, enhanced BASIC
Applications:- Cased single board with BASIC, can connect to Eurobus

ACORN
Dist:- As ATOM

CPU 6502 **I/O** PARA BUS **BASIC** NO **DISC** NO
RAM 1K/8K **CASS** CUTS **Other** NO **m/c** 2K
£65 upwards

Extras:- Rack based expansion capability inc Prestel.
Applications:- Single board controller with piggy back Hex + I/O.
Reviewed:- Aug '79

ADDS

ADDS SYSTEM 75
Dist:- ADDS (UK) Ltd.
137 High Street
New Malden, Surrey
01-949 1272
Sold through dealer network

CPU 8085A **I/O** RS232 COMS **BASIC** YES **DISC** 2x8"
RAM 52K **CASS** N/A **Other** Fortran uCobol **m/c** ADOS
£4,000 upwards, less printer

Extras:- Floppy, printer, system software
Applications:- Complete business system with supplied software and communications interface

Apple Computers

APPLE II
Dist:- Microsense,
Finway Road, Maylands Ave,
Hemel Hempstead,
Herts HP2 7LE
0442-48151
Over 200 regional dealers

CPU 6502 **I/O** Various **BASIC** 2 versions **DISC** OPT
RAM 16K/48K **CASS** YES **Other** Various **m/c** 2K
£695 upwards

Extras:- Various discs, colour graphics, I/O
Applications:- Neat cased system with excellent I/O capability including Prestel

Atari

ATARI 400
Dist:- Ingersoll Electronics
202 New North Road
London N1 7BL
01-226 1200

CPU 6502 **I/O** RS232 **BASIC** 18K **DISC**
RAM 8K/16K **CASS** YES **Other** **m/c** shared
£400

Extras:- Printer
Applications:- Programmable games system grown up to home computer.

ATARI 800
Dist:- As Atari 1400

CPU 6502 **I/O** RS232 **BASIC** 18K **DISC**
RAM 16K/48K **CASS** YES **Other** **m/c** shared
£750

Extras:- Printer, discs, plug in software, modem
Applications:- Expanded version of 400 with wider applications

Athena

ATHENA 8285
Dist:- Butel-Comco Ltd.
50 Oxford Street,
Southampton
Hants SO1 1DL
0703-39890

CPU 8085A **I/O** RS232 **BASIC** YES **DISC** 2x5¼"
RAM 64K **CASS** N/A **Other** Various **m/c** DOS
£3,380 upwards

Extras:- 8" discs, printer
Applications:- Complete integral desktop system

Attache

ATTACHE
Dist:- Friargrove Systems,

CPU Z80 **I/O** RS232
RAM 64K **CASS** N/A

Suite 62, Outer Temple,
222 The Strand,
London WC2R 1BA
01-353 8267

BASIC YES
DISC 2x8"

Other Various
m/c CP/M

£8,000

Extras:- Hard disc,
Applications:- Complete S100 based system with VDU, printer and software

Commodore Systems

PET
Dist:- Commodore,
360 Euston Road
London NW1 3BL
01-388 5702
+ many regional

CPU 6502
I/O IEEE
PARA
BASIC 8K
DISC

RAM 8K/32K
CASS YES
Other Forth
Pascal
m/c

£550 upwards

Extras:- Discs, printer, many options
Applications:- Original complete desktop system
Reviewed:- December '79

SUPER PET 8032
Dist:- As PET

CPU
I/O
BASIC
DISC

RAM
CASS
Other
m/c

Applications:- No information received at press deadline (UK release?)

Compshop

UK 101
Dist:- CompShop
14 Station Road
New Bennet,
Herts EN5 1QW
01-441 2922

CPU 6502
I/O RS232
PARA
BASIC 8K
DISC

RAM 4K/8K
CASS YES
Other NO
m/c 2K

£199 kit, £249 built

Extras:- Memory, I/O, kit or built
Applications:- UK implementation of Superboard

Compucolor

COMPUCOLOR II
Dist:- Dyad Developments
The Priory, Great Milton,
Oxon OX9 7PB
08446-729.

CPU 8080
I/O RS232
PARA
BASIC YES
DISC 5¼"

RAM 8K/32K
CASS NO
Other NO
m/c DOS

£1,200

Extras:- Second disc unit.
Applications:- Integral colour graphics system with limited expansion capabilities.
Reviewed:- June '79 & July '80

Cromemco

CROMEMCO SYSTEM 2
Dist:- Comart Ltd.
PO Box 2,
St Neots,
Huntingdon,
Cambs PE19 4NY
0480-215005
plus Datron & Edinburgh Micro Centre

CPU Z80
I/O RS232
PARA.P
BASIC Various
DISC 2x5¼"

RAM 64K
CASS N/A
Other Various
m/c CDOS

£2,095-£7,000

Extras:- Hard option disc, multiple user capability, printer, etc.
Applications:- Development system, S100 based, with a wide range of software

CROMEMCO Z2H
Dist:- As SYSTEM 2

CPU Z80A
I/O RS232
PARA.P
BASIC Various
DISC 10Mb H

RAM 64K
CASS N/A
Other Various
m/c CDOS

£5,373 upwards.

Extras:- Up to 6 hard discs, 8" floppies
Applications:- Development system, Fast data processor and data base with multi-user capability.

CROMEMCO SYSTEM 3
Dist:- As SYSTEM 3

CPU Z80
I/O RS232
PARA.P
BASIC Various
DISC 2x8"

RAM 64K
CASS N/A
Other Various
m/c CDOS

£3,745-£9,000

Extras:- Discs (inc hard), multi-user capability, printers, etc.
Applications:- S100 based professional system with a wide range of applications.

Digital Microsystems

DSC-2
Dist:- Modata Ltd,
30 St Johns Road
Tunbridge Wells,
Kent TN4 9NT
0892-41555

CPU Z80A
I/O RS232
PARA
BASIC Yes
DISC 2x8"

RAM 64K
CASS N/A
Other Various
m/c CP/M

£3,525-7,645

Extras:- Hard disc, extra floppies, various software
Applications:- Business machine of US origin.

DSC-3
Dist:- As DSC-2

CPU Z80A
I/O RS232
PARA
BASIC Yes
DISC 2x8"

RAM 64K
CASS N/A
Other Various
m/c CP/M

£3,445-6,995

Extras:- Hard disc, extra floppies.
Applications:- Can use one serial interface in RS422 mode and act as a Master/Slave in a network.

HDS-4000
Dist:- As DSC-2

CPU Z80A
I/O RS232
PARA
BASIC Yes
DISC 2x8" + Hd

RAM 64K
CASS N/A
Other Various
m/c CP/M

£6,745-7,645

Extras:- More disc storage
Applications:- Choice of two sizes of hard disc make for medium sized DP use.

Equinox

EQUINOX IMS 5000
Dist:- Equinox Computers,
Kleeman House
16 Anning Street,
New Inn Yard,
London EC2A 3HB
01-739 2387

CPU Z80
I/O RS232
PARA
BASIC YES
DISC 2x5¼"

RAM 32K/48K
CASS N/A
Other Various
m/c CP/M

£1,525 - £2,665

Extras:- 8" floppies, hard discs, VDU, printer, etc.
Applications:- S100 based system with integral disc drives

Eurocalc

EUROC
Dist:- Eurocalc Ltd.
128/132 Curtain Road,
London EC2

01-729 4555
+ Regional Distribution network soon

CPU	8080	**RAM**	64K
I/O	PARA	**CASS**	N/A
BASIC	YES	**Other**	Various
DISC	2x8"	**m/c**	CP/M

£8,000

Extras:- Printers, WP keyboard, hard disc
Applications:- Plessey manufactured system supplied complete with software and hardware

Exidy

EXIDY SORCERER
Dist:- Liverport Data Products
The Ivory Works,
St Ives, Cornwall
0736-798157
+ regional dealers

CPU	Z80	**RAM**	16K/48K
I/O	RS232 PARA	**CASS**	2
BASIC	Plug In 8K	**Other**	On disc
DISC	OPT	**m/c**	4K

£749 upwards

Extras:- Discs, printer, S100 adapter, ROM PACs
Applications:- Keyboard based system using 'plug-in' software and expanding to discs

Heath Electronics

HEATHKIT H8
Dist:- Heath Electronics,
Bristol Road
Gloucester GL2 6EE
0452-29451
+ London shop (01-636 7349)

CPU	8080	**RAM**	4K/56K
I/O	Various	**CASS**	YES
BASIC	YES	**Other**	Various on disc
DISC	OPT	**m/c**	4K

£275 upwards

Extras:- Discs, printer, VDU
Applications:- Bus based kit system of superb quality, large expansion possible

Hewart Microelectronics

HEWART 6800S
Dist:- Hewart Microelectronics
95 Blakelow Road,
Macclesfield,
Cheshire SK11 7ED
0625-22030

CPU	6800	**RAM**	16K/32K
I/O	RS232 PARA	**CASS**	2
BASIC	OPT 8K	**Other**	Pascal
DISC		**m/c**	1K/2K

£299 inc. keyboard

Extras:- 6809 upgrade, floppy discs using FLEX, case
Applications:- Naked 6800 development system.

HEWART 6800 MK4
Dist:- As 6800S

CPU	6800	**RAM**	16K/48K
I/O	choice	**CASS**	2
BASIC	OPT	**Other**	OPT
DISC	OPT	**m/c**	

£160 upwards.

Extras:- SS50 range of boards.
Applications:- Naked bus based system, found useful in education/control.

Hewlett Packard

HP 85
Dist:- Hewlett Packard
King Street Lane,
Winnersh,
Wokingham, Berkshire
0734-784774

CPU	CUSTOM	**RAM**	16K/32K
I/O	IEEE RS232	**CASS**	CART
BASIC	32K	**Other**	
DISC	OPT	**m/c**	NO

£2,300

Extras:- All HP range of goodies.
Applications:- Integral printer system for desktop scientific use.
Reviewed:- April '80, June '80

Interec Data Systems

SUPERBRAIN
Dist:- Sun Computers,
138 Chalmers Way
North Feltham Trading Estate
Feltham, Middx.
01-751 6695.

CPU	2xZ80	**RAM**	32K/64K
I/O	RS232	**CASS**	N/A
BASIC	YES	**Other**	Various
DISC	2x5¼"	**m/c**	CP/M

£1,950 upwards

Extras:- 8" disc, standard software.
Applications:- S100 bus based complete unit of smart desktop type.

Ithaca Intersystems

ITHACA INTERSYSTEM 2
Dist:- Transam,
59-61 Theobalds Road
London WC1
01-405 5240
+ regional dealers

CPU	Z80A	**RAM**	8K/64K
I/O	Various	**CASS**	N/A
BASIC	YES	**Other**	Various
DISC	5¼" or 8"	**m/c**	CP/M

£700 upward

Extras:- Full range of S100 boards to IEEE spec.
Applications:- Flexible system that can be adapted to a wide range of uses.

ITT Consumer Products

ITT 2020
Dist:- Telefusion Ltd.,
61 Queens Square
Bristol
0272-211446
+ many regional stockists

CPU	6502	**RAM**	16K/48K
I/O	Various	**CASS**	YES
BASIC	Various	**Other**	Pascal
DISC	OPT	**m/c**	2K

£750 - £1,500

Extras:- Discs, Prestel, printers.
Applications:- As Apple II, compatible UK version with standard colour graphics.
Reviewed:- March '80

Luxor

ABC 80
Dist:- CCS Microsales,
7 The Arcade,
Letchworth, Herts.
04626-73301

+ 1 other

CPU	Z80	**RAM**	16K/40K
I/O	IEEE RS232	**CASS**	YES
BASIC	16K	**Other**	Pascal
DISC	2x5¼"	**m/c**	2K

£749

Extras:- Mainly software, I/O
Applications:- Complete cased system, Viewdata compatible

Microdata Computers

MICROLINK 1
Dist:- Microdata Computers,
Belvedere Works, Bilton Way,
Pump Lane Industrial Estate,
Hayes, Middx UB3 3ND
01-848 9871

CPU	Z80/F8	**RAM**	16K/32K
I/O	RS232 PARA	**CASS**	CUTS 1200Bd
BASIC	8K	**Other**	Pascal soon
DISC	NO	**m/c**	3K

£3,500 upwards

Extras:- Printer, modem, etc.
Applications:- Portable data terminal using plasma flat screen display

Micro V

MICROSTAR 45
Dist:- Microsense
Finway Road, Maylands Avenue

CPU	8085A	**RAM**	64K
I/O	RS232	**CASS**	N/A
BASIC	YES	**Other**	Various

Hemel Hempstead,
Herts HP2 7LE
0442-48151
+ small dealer network

DISC 2x8" **m/c** *DOS CP/M
£4,800

Extras:- 20 M6 hard disc, VDU, printer
Applications:- Multi user business system

Midwest Scientific Instruments

MSI 6800 SYSTEMS
Dist:- Strumech,
Portland House, Coppice Side
Brownhills, Walsall
West Midlands
05433-4321

CPU 6800 **RAM** 16K/56K
I/O RS232 **CASS** OPT
BASIC YES **Other** Various
DISC OPT **m/c** 1K+FDOS
£1,200 upwards

Extras:- Floppies, hard disc, printer, VDU.
Applications:- Ready built SS50 system expanding to full "System 12" with hard disc.

Nascom Microcomputers

NASCOM 1
Dist:- Nascom
92 Broad Street
Chesham, Bucks HP5 3ED
02405-75151
+ regional network

CPU Z80 **RAM** 1K/6K
I/O RS232 **CASS** YES
PARA
BASIC OPT **Other**
DISC **m/c** 1K
£125

Extras:- Motherboard, RAM, printer.
Applications:- Full keyboard machine code system, expandable.

NASCOM 2
Dist:- As NASCOM 1

CPU Z80 **RAM** 9K
I/O RS232 **CASS** Kansas
PARA
BASIC 8K **Other**
DISC **m/c** 2K
£225

Extras:- Printer, RAM, case, discs.
Applications:- Low cost kit system, developed from Nascom 1.
Reviewed:- February '80

National Panasonic

PANASONIC JD800/840
Dist:- Panasonic Business Equip.
9 Connaught Street
London W2 2AY
01-262 3121
+ regional distributors

CPU 8085A **RAM** 56K
I/O RS232 **CASS** N/A
BASIC YES **Other** Cobol
DISC 2x8" **m/c** CP/M
£4,275 (hardware)
£8,000 upwards for packages

Extras:- Printers and software from regional distributors.
Applications:- Complete small business system with software support

Newbear

77-68
Dist:- Newbear,
40 Bartholomew Street
Newbury, Berks.
0635-30505
+ 2 regional shops

CPU 6800 **RAM** 4K/56K
I/O Various **CASS** YES
BASIC OPT **Other** NO
DISC **m/c** 1K
£40 upwards

Extras:- 6809 upgrade, I/O, discs
Applications:- Rack based kit system.

Netronics

ELF II
Dist:- Newtronics,
255 Archway Road
London N6
01-348 3325

CPU 1802 **RAM** ¼/4K
I/O PARA **CASS** OPT
BASIC OPT **Other**
DISC **m/c** 1K
£60

Extras:- Motherboard, RAM, I/O.
Applications:- Low cost kit for Hex programming.
Reviewed:- October '79

EXPLORER 85
Dist:- As ELF II
255 Archway Road
London N6
01-348 3325

CPU 8085 **RAM** 4K
I/O PARA **CASS** YES
BASIC 8K OPT **Other**
DISC **m/c** 2K
£285 upwards

Extras:- Normal S100 goodies, case.
Applications:- Kit, S100 based.
Reviewed:- June '80

North Star

NORTHSTAR HORIZON
Dist:- Comart Ltd.,
P.O. Box 2, St Neots
Huntingdon, Cambs PE19 4NY
0480-215005
+ many regional dealers

CPU Z80 **RAM** 32K/56K
I/O RS232 **CASS** N/A
PARA
BASIC YES **Other** Various
DISC 2x5¼" **m/c** CP/M
£1,600 - 2,000

Extras:- Discs, VDU, printer.
Applications:- S100 based system with good software support.

Ohio Scientific Instruments

SUPERBOARD II,[C1]
Dist:- Mutek,
Quarry Hill, Box, Wiltshire.
0225-743289
+ many regional

CPU 6502 **RAM** 4K/8K
I/O PARA **CASS** YES
BUS
BASIC 8K **Other** NO
DISC NO **m/c** 2K
£150
cased + psu + mod = C1 @ £220

Extras:- Discs, Memory, case.
Applications:- Naked single board with BASIC, modified display for UK market.
Reviewed:- July '79

CHALLENGER, C2
Dist:- As SUPERBOARD II

CPU 6502 **RAM** 4K/32K
I/O RS232 **CASS** Kansas
PARA
BASIC 8K **Other** NO
DISC OPT **m/c** 2K
£349

Extras:- Disc, printer, memory.
Applications:- 4 slot backplane machine, upgraded system.

CHALLENGER, C4
Dist:- As SUPERBOARD II

CPU 6502 **RAM** 8K/32K
I/O RS232 **CASS** YES
PARA
BASIC 8K **Other** NO
DISC OPT **m/c** 4K
£395

Extras:- Disc, printers, etc.
Applications:- Upgraded C2 with colour graphics.

CHALLENGER, C8P
Dist:- As SUPERBOARD II

CPU 6502 **RAM** 8K/32K
I/O RS232 **CASS** YES
PARA
BASIC 8K **Other** NO
DISC OPT **m/c** 4K
£475

Extras:- Disc, printers, etc.
Applications:- Upgraded C2 with colour graphics.

CHALLENGER, C3
Dist:- As SUPERBOARD II

CPU	6502 6800 + Z80	**RAM**	48K/58K
I/O	Various	**CASS**	N/A
BASIC	YES	**Other**	Various
DISC	2x8"	**m/c**	DOS

£2,450

Extras:- VDU, printer, software
Applications:- Triple CPU system for business use etc.

Ontel

JEMINI
Dist:- Jaserve Ltd.
Stanhope Road,
Camberley, Surrey
0276-62282

CPU	8085A	**RAM**	52K/64K
I/O	RS232	**CASS**	N/A
BASIC	YES	**Other**	Various

£9,200 upwards

Extras:- WP Software, printers, etc.
Applications:- VDU based package system.

Periflex

PERIFLEX 630/48
Dist:- Sintrom
Arkwright Road, Reading
Berks. RG2 0LS
0734-85464

CPU	Z80	**RAM**	48K
I/O	Various	**CASS**	N/A
BASIC	various	**Other**	Various
DISC	2x5¼"	**m/c**	CP/M2

£2,500

Extras:- VDU, printers, S100 board set.
Applications:- S100 based systems.

PERIFLEX 1024/64
Dist:- As 630/48

CPU	Z80	**RAM**	64K
I/O	Various	**CASS**	N/A
BASIC	Various	**Other**	Various
DISC	2x8"	**m/c**	CP/M 2

£3,300

Extras:- VDU, printers.
Applications:- S100 based boxed computer.

Powerhouse

POWERHOUSE 2
Dist:- Powerhouse,
5 Alexandra Road
Hemel Hempstead,
Herts HP2 5BS
0442-48422

CPU	Z80A	**RAM**	32K/64K
I/O	RS232 PARA.P	**CASS**	YES
BASIC	Yes	**Other**	No
DISC	OPT	**m/c**	2K

£1,250

Extras:- Graphics, I/O, printer.
Applications:- 5" VDU based system used in scientific and industrial control.

POWERHOUSE 3
Dist:- As POWERHOUSE 2

CPU	Z80A	**RAM**	32K/64K
I/O	RS232 PARA.P	**CASS**	N/A
BASIC	Yes	**Other**	Various
DISC	2x5¼"	**m/c**	CP/M

£2,250-£2,750

Extras:- Graphics, I/O, printer.
Applications:- 9" VDU based system with potential DP and small business applications.

Powertran

PSI COMP 80
Dist:- Powertron Electronics
Portway Industrial Estate
Andover, Hants SP10 3MN
0264-64456

CPU	Z80	**RAM**	3K/32K
I/O	Various	**CASS**	Kansas
BASIC	2K	**Other**	NO
DISC		**m/c**	1K

£255

Applications:- Mathematical/number crunching with special on-board chip.

Rair

BLACK BOX
Dist:- Rair Ltd.
30-32 Neal Street,
London WC2H 9PS
01-836 4663

CPU	8085A	**RAM**	32K/64K
I/O	RS232	**CASS**	N/A
BASIC	Various	**Other**	Various
DISC	2x5¼"	**m/c**	CP/M

£2,500 upwards

Extras:- VDU's, printer, hard and floppy discs.
Applications:- Disc based professional system capable of handling up to 16 terminals.

Research Machines

RML 380Z
Dist:- Research Machines
P.O. Box 75,
Mill St, Oxford
0865-49791

CPU	Z80	**RAM**	16K/56K
I/O	Various	**CASS**	YES
BASIC	YES	**Other**	Various
DISC	OPT	**m/c**	3K

£897 upwards

Extras:- Graphics, printer, etc.
Applications:- Educational system of high quality.

Rockwell

AIM 65
Dist:- Pelco Electronics
Enterprise House,
83-85 Western Road
Hove, Sussex BN3 1UB
0273-722155
+ several regional outlets

CPU	6502	**RAM**	1K/4K
I/O	RS232 PARA	**CASS**	2
BASIC	8K op	**Other**	
DISC		**m/c**	8K

£265 upwards

Extras:- Discs, RAM, VDU, cases, etc
Applications:- Versatile single board with single line display and thermal printer.
Reviewed:- Dec '79

Sanyo

SYSTEM 7000
Dist:- Memory Computers (UK)
Denjon House,
11 Denmark Street,
London WC2
021-455 8686

CPU	Z80	**RAM**	32K/64K
I/O	RS232	**CASS**	N/A
BASIC	Yes	**Other**	Various
DISC	2x5¼"	**m/c**	CP/M

£6,950 (complete systems)

Extras:- 8" floppies, printers, etc
Applications:- Complete VDU based system well established in Europe.

SGS Ates

NANOCOMPUTER
Dist:- SGS Ates/Midwich
9 Churchgate Street,
Old Harlow, Essex CM17 0JS
0279-412605

CPU	Z80	**RAM**	4K/16K
I/O	RS232 2xPIO	**CASS**	YES
BASIC	8K opt	**Other**	
DISC		**m/c**	2K

£240 upwards

Extras:- Experimenter systems, full system capability.
Applications:- Educational single board that can grow to fill system.
Reviewed:- Aug '79

Sinclair Research

ZX80
Dist:- Science of Cambridge
6, Kings Parade
Cambridge, Cambs CB2 1SN
0223-311488

CPU	Z80A	**RAM**	1K/16K
I/O	PARA BUS	**CASS**	YES
BASIC	YES	**Other**	NO
DISC	NO	**m/c**	

£80 kit, £100 built

Extras:- Kit or ready built, PSU, 16K RAM 8K BASIC
Applications:- Touch keyboard, low-cost beginners/educational system
Reviewed:- June '80

Sharp Electronics

MZ-80K
Dist:- Sharp UK Ltd.
Thorn Road, Newton Heath,
Manchester M10 9BE
061-205 2333
+ growing regional

CPU	Z80	**RAM**	6K/34K
I/O	PARA	**CASS**	YES
BASIC	14K	**Other**	
DISC		**m/c**	4K

£480 to £599

Extras:- Discs, printer, I/O adaptor
Applications:- Japanese desktop system expanding to business market

PC 1211
Dist:- As MZ-80K

CPU	Unknown	**RAM**	
I/O	NO	**CASS**	YES
BASIC	YES	**Other**	NO
DISC	NO	**m/c**	NO

£120 approx inc cassette adaptor

Extras:- Printer adaptor soon.
Applications:- 1424 step BASIC programmable handheld computer using LCD display.

Smoke Signal

SMOKE SIGNAL CHIEFTAIN
Dist:- Strumech
Portland House, Coppice Side,
Brownhills, Walsall
West Midlands
05433-4321
+ Windrush

CPU	6800	**RAM**	32K/56K
I/O	RS232 SS50 BUS	**CASS**	N/A
BASIC	YES	**Other**	Various
DISC	OPT	**m/c**	1K + DOS

£3,000

Extras:- Floppies, printers, VDUs.
Applications:- Mainly supplied to education and research although suitable for business.

Sord

M100 ACE Mk III
Dist:- Exleigh Business
Machines Ltd.
11 Market Place, Penzance
Cornwall TR18 2JB
0736-66577
+ some regional outlets,
Midas etc.

CPU	Z80	**RAM**	48K
I/O	Various	**CASS**	N/A
BASIC	YES	**Other**	Fortran
DISC	2x5¼"	**m/c**	

£2,259

Extras:- More discs, Colour graphics
Applications:- Personal or small business machine from Japan based on the S100 bus.

M203 Mk III
Dist:- As M100 ACE

CPU	Z80A	**RAM**	64K
I/O	Various	**CASS**	N/A
BASIC	YES	**Other**	Various
DISC	2x5¼"	**m/c**	CAP.BOS

£2,979

Extras:- 2 x 8" floppies, 2 more 5¼" floppies
Applications:- Process control, wordprocessing, business system with CAP/CPP software

M223 Mk III
Dist:- As M100 ACE

CPU	Z80A	**RAM**	64K
I/O	Various	**CASS**	N/A
BASIC	YES	**Other**	Various
DISC	2x5¼"	**m/c**	CAP.BOS

£3,489

Extras:- 4 x 8" floppies, more 5¼" floppies, up to 4 x 8 Mb Hard disc.
Applications:- As the M203 but with a full S100 bus to allow system expanson.

Southwest Technical Products

SWTP 6800/6809
Dist:- Southwest Technical
38 Dover Street,
London W1X 3RB
01-491 7507

CPU	6800 6809	**RAM**	8K/56K
I/O	Various	**CASS**	YES
BASIC	Various	**Other**	Various
DISC	OPT	**m/c**	2K

Extras:- Discs, printer, VDU.
Applications:- SS50 based system with good software support.

Tandy Corporation

TRS-80 Level 1 & 2
Dist:- Tandy Corp.,
Bilston Road, Wednesbury
West Midlands WS10 7JN
021-556 6101
+ regional shops

CPU	Z80	**RAM**	4K/48K
I/O	OPT	**CASS**	YES
BASIC	2 versions	**Other**	Fortran
DISC	OPT	**m/c**	4K

£380 - £560

Extras:- Discs, printers, I/O.
Applications:- Top selling system with "separates" approach.
Reviewed:- November '79

TRS-80 II
Dist:- As TRS-80

CPU	Z80	**RAM**	32K/64K
I/O	RS232 PARA	**CASS**	N/A
BASIC	YES	**Other**	
DISC	8"	**m/c**	

£2,000 upwards

Extras:- Printer, disc.
Applications:- Upgraded business version of Model I.

Tangerine Computers

MICROTAN 65
Dist:- Tangerine Computers
Forehill, Ely, Cambs.
+ regional dealers
0353-3633

CPU	6502	**RAM**	1K/48K
I/O	PARA BUS	**CASS**	OPT
BASIC	OPT 10K	**Other**	NO
DISC	NO	**m/c**	1K

£69 upwards

Extras:- Tanex board for I/O, BASIC, etc + racking,cases.
Applications:- Machine code system, kit or built that expands to a full computer.
Reviewed:- June '80

MICRON
Dist:- As MICROTAN 65

CPU	6502	**RAM**	8K
I/O	RS232 PARA	**CASS**	YES
BASIC	10K	**Other**	NO
DISC	NO	**m/c**	3K

£395 inc

Extras:- RAM, Discs, I/O rack system
Applications:- Cased built system with excellent expansion possibilites
Reviewed:- October '80

Technalogics

TECS
Dist:- Technalogics
8 Egerton St.Liverpool,
Merseyside L8 7LY
051-724 2695
+1 Regional Distributor

CPU	6800	**RAM**	16K/56K
I/O	RS232 PARA	**CASS**	2
BASIC	3K	**Other**	YES
DISC	OPT	**m/c**	4K

Extras:- Discs/Memory Prestel Software
Applications:- Prestel/Teletext terminal option to home system
Reviewed:- May '79

Texas Electronic Instruments

TEI 208-212
Dist:- Abacus,
62 New Cavendish Street,
London W1M 7LD
01-580 8841

CPU	Choice	**RAM**	32K/60K
I/O	PARA SERIAL	**CASS**	N/A
BASIC	YES	**Other**	Various
DISC	2x5¼"	**m/c**	CP/M

£3,535-4,497

Extras:- 8" discs (212) printers, hard disc soon
Applications:- Integral VDU models forming the basis of a business system

Texas Instruments

TI 99/4
Dist:- Texas Instruments,
European Consumer Division,
Manton Lane Bedford MK41
7PA
0234-67466
+ dealer network

CPU	9900	**RAM**	16K
I/O	PARA BUS	**CASS**	2
BASIC	14K	**Other**	NO
DISC	OPT	**m/c**	12K

£995

Extras:- Discs, speech synthesiser
Applications:- Colour graphics machine with "plug-in" software Needs US TV, soon to change

Transam

TRITON
Dist:- Transam,
59-61 Theobalds Road,
London WC1
01-405 5240

CPU	8080	**RAM**	1K/3K
I/O	PARA BUS	**CASS**	YES
BASIC	Various	**Other**	Pascal
DISC	OPT	**m/c**	Various

£294 to £1,000

Extras:- Cases, Discs, Motherboard, Assembler package
Applications:- Versions available for most requirements, from educational to research
Reviewed:- May '80

TUSCAN
Dist:- As TRITON

CPU	Z80	**RAM**	1K/8K
I/O	RS232 PARA	**CASS**	YES
BASIC	OPT	**Other**	Pascal
DISC	OPT	**m/c**	2K

£195 upwards

Extras:- Casing, VDU option, discs, Firmware, S100 boards
Applications:- S100 based kit, development style system. Also ready built

Vector Graphic

SYSTEM B
Dist:- Sintrom,
Arkwright Road Reading
Berks RG2 0LS
0734-85464
+ many regional

CPU	Z80	**RAM**	64K
I/O	RS232 PARA	**CASS**	N/A
BASIC	Various	**Other**	Various
DISC	2x5¼"	**m/c**	CP/M 2

£3,200 upwards

Extras:- Printer, software, S100 boards
Applications:- Serious computing package complete with VDU and software

VECTOR GRAPHIC 2800
Dist:- As SYSTEM B

CPU	Z80	**RAM**	64K
I/O	SERIAL PARA	**CASS**	N/A
BASIC	Various	**Other**	Various
DISC	2x8"	**m/c**	CP/M 2

£3,995 upwards

Extras:- Printers, S100 boards, software

Applications:- Data processing and scientific/industrial computing. Terminal based system.

VECTOR GRAPHIC 3030
Dist:- As SYSTEM B

CPU	Z80	**RAM**	64K
I/O	SERIAL PARA	**CASS**	N/A
BASIC	Various	**Other**	Various
DISC	2x5¼" 32M6HB	**m/c**	CP/M 2

£TBA

Extras:- Printers, S100 boards, software.
Applications:- Hard disc based terminal system for DP

Video Genie

VIDEO GENIE
Dist:- Lowe Electronics
Bentley Bridge, Chesterfield Road,
Matlock, Derbyshire DE4 LEF
0629-2817
+ dealer network

CPU	Z80	**RAM**	16K/48K
I/O	PARA BUS	**CASS**	YES
BASIC	10K	**Other**	
DISC		**m/c**	2L

£425 inc VAT

Extras:- Printer, discs via Tandy.
Applications:- HONG KONG copy of TRS-80 which also runs Level 2 software.

Xerox

DIABLO 3000
Dist:- Business Computers.
The Pagoda, Theobald Street,
Borehamwood, Herts WD6 4RT
01-207 3344

CPU	8085	**RAM**	32K/64K
I/O	RS232	**CASS**	N/A
BASIC	YES	**Other**	DACL
DISC	2x8"	**m/c**	DOS

£8,950-£15,000

Extras:- Business software, Printer, Communications adapter
Applications:- Complete business system that can be multi-tasked. Price includes software.

DIABLO RANGER 3200
Dist:- As DIABLO 3000

CPU	8080	**RAM**	32K/64K
I/O	RS232	**CASS**	N/A
BASIC	YES	**Other**	DACL
DISC	2x8"	**m/c**	DOS

£10,865-£50,000

Extras:- Up to 4 discs, Up to 2 hard discs, Printers, Communications adapter.
Applications:- Complete system that can run up to eight jobs simultaneously, price includes software.

Zenith Data Systems

ZENITH Z89
Dist:- Zenith Data Systems.
Heath Electronics.
Bristol Road,
Gloucester GL2 6EE
0452-29451
+ London shop 01-636 7349

CPU	Z80	**RAM**	16K/64K
I/O	RS232	**CASS**	OPT (H88)
BASIC	YES	**Other**	Various
DISC	5¼"	**m/c**	8K

£1,570 upwards

Extras:- Dual 8" discs, printer
Applications:- Integrated system of very high quality, also available as a kit.
Reviewed:- June '80

ZENITH Z11
Dist:- As Z89

CPU	LSI 11	**RAM**	16K/32K
I/O	Various	**CASS**	N/A
BASIC	YES	**Other**	Various
DISC	OPT2x8"	**m/c**	N/A

£1,250

Extras:- Discs, printer, VDU
Applications:- LSI 11 compatible 16 bit system.

Photocopies of system reviews are available by post from our offices priced £1 each

CLASSIFIEDS

RATES

1-3 insertions £5.50 per scc
4-11 insertions £5.00 per scc
12 insertions £4.50 per scc
21p per word (Min 20 words)
Box No. on application

All advertisements in this section must be pre-paid

Closing Date:- 2nd Fri month preceding publication

Advertisements are accepted subject to the terms and conditions printed on the advertisement rate card (available on request)

SEND TO:– CT CLASSIFIED, 145, CHARING CROSS RD, LONDON WC2H 0EE TEL: 01-437 1002 Ext. 26

PET 16K, New ROM, books, mags, and £500 worth of programs. £600 o.n.o. Phone Oxford 93351 ext. 215 between 2pm-6pm.

PET SPECIAL OFFER. £25.50. 8 Channel (1 amp) relay driver board for PET user port. Can also be used for inputting data. LED indicators on each channel. Kent Microsystems, 5-6 Mansion Street, off Fort Road, Margate, Kent.

INTEL 2758 Eproms 450nS access time, 1k x 8, 5v supply only. Complete with data sheet. £7.50 each inclusive. S.E. Mabery, 5 Caxton Street, Middlesbrough, Cleveland. TS56AH.

INTEL 2758 Eproms 450nS access time, 1k x 8, 5v supply only. Complete with data sheet. £7.50 each inclusive. S.E. Mabery, 5 Caxton Street, Middlesbrough, Cleveland. TS5 6AH.

ZX80 MOVING GRAPHICS using external circuitry. Circuit diagrams, details plus 3 programs £2.
CHEAP ZX80 Model Controller Interface Details, circuits £1.50. M.Orme, 24, Margaret Gardens, Wadebridge, Cornwall

ZX80. National Users Club. SAE for details, 44 Earls Court Road, London W8 6EJ.

RECHARGEABLE BATTERIES

TRADE ENQUIRIES WELCOME
FULL RANGE AVAILABLE. S.A.E. FOR LISTS. £1.45 for Booklet. "Nickel Cadmium Power" plus Catalogue. Write or call: Sandwell Plant Ltd., 2 Union Drive, BOLDMERE, SUTTON COLDFIELD, WEST MIDLANDS. 021-354 9764, or see them at TLC, 32 Cravens Street, Charing Cross, London. W.C.2

PLUG-IN Ram cards, suit ZX-80 1K-£20; 2K-£30; 3K-£40. Send order to Quicksilva, 56, Bedford Place, Sotton, Hants. or SAE for Data.

SINGLE RAIL **2716's**
1 + £10.00 4 + £9.50
5% Club Discount p + p 50p
A.B.J. Low, Montefiore House, Wessex Lane, Swaythling, Southampton.

GLASGOW
TRS 80
Keyboards,Systems. Discs.Printers etc.
VICTOR MORRIS
TANDY DEALER
340 ARGYLE ST. GLASGOW G2
Tel 041 221 8958 Telex 779874

NANOCOMPUTER plus power supply, unused, £240 o.n.o. Phone John Reid on Aylesbury 86500 (work hours).

PICO BASIC for Mk14's with 1½k extra RAM. Interpreter listing £5, tape £5, set of program listings £2, P&P included. Seal, Greenwood Cottage, Bockhampton, DT2 8PZ.

ZX80 GAMES. Mastercode, Simon Says, Dr Who, Alien Invader (for 2 players). The 4 on cassette plus free leaflet on Cure for Load/Save Problem plus How to Save £8 per K on Additional Memory. Send £3 or SAE details. Bobker, 29 Chadderton Drive, Unsworth, Bury, Lancs.

TRS 80 16K Level II with VDU and cassette. Less than 12 months old. Many taped programs. £400 o.n.o. Phone Glos (0452) 31087 evenings.

WANTED. Bridge and Chess programs for NASCOM 1. Alternatively, would consider second-hand games machines. Details please, to Crawford, 13 Church St., Broadway, Worcs.

COMPLETE 6809 100 Computer System comprising Microdasys 6809 SBC processor 24K RAM, VDU, keyboard, BASIC, beautiful Vector VPI case, many extras. £800. Ring for details, Aaron 01-959 4851.

ZX-80 BRANDS Hatch. The ultimate game for a 2K ZX-80. Original, compelling, frustrating. Send only £1.00 plus SAE for full documentation. Same day despatch. M. Millward, 1 Park Avenue, Ilkeston, Derbyshire. DE7 5DH.

uHEX EPROM PROGRAMMERS

426 2508/2708/2758/2516/2716
Dual and Single supply Eproms, **£95**

416 2704/2708/2716 Dual only, **£65**

480 2704/2708 Kit **£35**. Built **£40**

All programmers require only standard power supplies.
The 426 and 416 are cased and have push-button selection.
Program any length block into the Eprom.
Software included. Range covers Z80, 8080, 6800 and 6500. State machine.

PIO, PIA INTERFACE MODULES
Available for Z80/8080 and 6800/6500.

Prices include carriage. Please add VAT. SAE for further product information.

MICROHEX COMPUTERS
Union St, Trowbridge, Wilts.

NEW! WORLD'S FIRST
SHARP POCKET COMPUTER PC-1211
to **ELKAN ELECTRONICS**

P1 RECORD MANAGEMENT SYSTEM
PET (min 16k, new ROM) database system, user defined records. Search/Sort on any field. Update randomly/serially. Save/Load files on tape or disk. Interrogation — interactive/batched. Documentation and detailed examples included
£55 (inc. tape)

P2 CROSSNUMBER PUZZLES
Generates crossnumber puzzles (not interactive). Clues are arithmetic sums, at a selected level or revision upto that level. Solutions also generated £5 (PET or SWTP tape £1 extra)

G1 AIRCRAFT LANDING SIMULATION
Real time using PET graphics. Try your hand at landing an aircraft in varying visibility
PET tape £4

G2 GRAVEYARD
Real time using PET graphics. Game for one player, object survival, requirements quick thinking and nimble fingers. PET tape £4

(p & p FREE, SAE for more details)

EXCEL COMPUTER PROGRAMS
4 Empress Ave., Fulwood, Preston PR2 4JT

ENHANCED SUPERBOARD
48 x 32 Display @ 2 MHz £225
Upgrading Service £42
Upgrading Kit + Inst £27
UK101/S BOARD METAL CASE £38

Northern Micro, 29 Moorcroft Park, New Mill, Huddersfield, HD7 7NH
Prices Inc All Charges. Tel. Holmfirth (04849) 2062 Any Time

ZX80-TREK. The Classic Game for your 4K machine! Klingons, phasers, scanning, all features. Send £5 for cassette to J. King, 214 St Leonards Road, London SW14.

INTENSIVE COURSES IN
BASIC
AND
PASCAL

Including hands on mini-computer operation.
These intensive courses are intended to instruct from minimal knowledge to an operational capability of computer programming. Advanced courses also available. Courses are fully residential allowing maximum instruction and programming time for the respective periods.
BASIC – Weekend from Friday evening to Sunday afternoon.
PASCAL – Full week Monday morning to Friday Afternoon.

For further details, dates available and fees, etc. Phone (0401) 43139 or write: Dept CT3, Cleveland Business Services, Cleveland House, Routh, Beverley, North Humberside.

TRITON L5-1, 4K RAM, with modified 12" portable TV, with direct video input, plus cassette recorder. £250 complete, or £190 computer. Tel. Hoddesdon (Herts) 63099.

ELECTRONIC KITS. Largest range of kits in the U.K. Everything from Stroboscopic Lights to Transmitters, at unbeatable prices — send SAE for free catalogue to: Eastling Electronics (Kits), 64b Hawthorn Road, Winton, Bournemouth.

TRS-80 4K Level 1. Plugs into any domestic TV. 5 months old, boxed as new. Must sell — wife wants deep freeze. £230 or offer. Phone Beaconsfield 3560 week-nights.

TRS 80 LEVEL 1, 4K only. The perfect game of Othello with all invalid moves, one number entry, and constant score for 2 players. Provisions have been made for you to work out a "sub" for 1 player. V computer with 10 variables and over 1,000 bytes. Cassette and instructions £2. Leon, 32 Wick Cresc, Brislington, Bristol, BS4 4HG.

INTEL 2758 Eproms 450nS access time, 1k x 8, 5v supply only. Complete with data sheet. £7.50 each inclusive. S.E. Mabery, 5 Caxton Street, Middlesbrough, Cleveland. TS5 6AH.

PET 2001-8 with additional 16K. i.e. 24K total, plus 3040 dual drive floppy disc, plus 50 programs including Teach Yourself BASIC. £1,250 o.n.o. Will separate. Tel: Offley 247.

MICROTAN 65 keypad manual £75. J. Swede 01-734 4275 (8-5pm). 01-603 4907 (evenings).

TEXT: Centronics Matrix Printer 779, 125 c.p.s. Unused condition, manuals included. £760 o.n.o. Phone Paul High Wycombe (0494) 716691 (evenings).

UK101 8K RAM, cased, new monitor, software, Ohio 610 expansion board with 8K RAM. RS232 teletype and interface, VDU. £500 or may split. Blackburn (0254) 61759. (eves/weekend).

2708/2716 (triple rail) Fast Erasing/Programming Service. 2708 £3. 2716 £5. From your Hex (or copy your eprom). New 2708 £6 each Petron Electronics, 1 Courtlands Road, Newton Abbott, Devon, TQ12 2JA.

TRS-80, 16K with Level II BASIC. Complete with screen. Complete with screen, cassette deck, documentation and data cassettes. £399. Phone Marlow 26811 GX 2353 (normal working hours).

AD INDEX

6800 SOFTWARE

*EDITOR ASSEMBLER supports all Motorola mnemonics and directives FCC, FCB, FDB, ORG, EQU, RMB, REM. 4K ROMABLE AT B000, LISTING AND MANUAL **£19.65**

*DISASSEMBLER very powerful converts object code to source code in a format suitable for Reassembly. Has double check for valid Opcode. Appx 2K Data/Listing **£7.50**

*SPACE INVADERS in 6800 m/c code. 56 invaders, 3 defences, score counter, etc. Requires M.M.VDU at 8800. Approx. 2K **£4.50**

*Other software includes: Basics, monitors, games, etc. Send 50p for catalogue (refundable first purchase).

No. 2 Glensdale Street, Leeds LS9 9JJ
Tel: Leeds 480987.J.MORRISON(MICROS)

NASCOM USERS — BASIC assist. Line renumber, find/change strings, list, list variables used, etc. Fully relocatable, full instructions, £6.50. Also GOMOKU, 3K object code, 3 skill levels, £3.60. Cassette (CUTS), NASSYS. P. Johnson, 14 Shelley Close, Winchester.

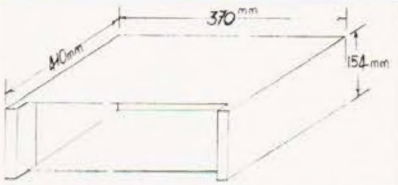
PET COMMODORE Business Computer. 32K with cassette, disc, printer with programs & paper. £2,000 o.n.o. Many extras. Phone 062484-2942.

CHEAP PRINT. NASCOM or TRITON — Complete package. Rebuilt surplus teleprinter, fitted interface, driving software, & paper. All you need for hard copy. These are rebuilts to like new condition and print on plain paper rolls or sheets with a quality typeface, not dot matrix, (upper case only). Guaranteed satisfaction at £58.50 plus carriage, (£9.00 in South and Midlands). SAE for sample printout to: Iolo Davidson, Littlefield, Hawling, Gloucestershire, GL54 5SZ.

TRITON COMPUTER for sale with Motherboard. L72 monitor and 8K BASIC & full on board RAM & one filled 8K RAM card. All fully cased with documentation and software. Offers around £500. Phone High Wycombe 28636.

ZX80 and PC1211 Software. Send SAE for our catalogue. Syntax Software, Dept. CT11, 25 Lynton Crescent, Gants Hill, Ilford, Essex.

ZX80 'SPACE ESCAPE'. Original, challenging game for 1K ZX80. Send £1.00 for listing to Irwan Owen, Rannoch, Heath Ridge Green, Cobham, Surrey KT11 2QJ.



NEW!! HIGH QUALITY EX-EQUIPMENT PROJECT CASES. Size 410x154x370mm

Attractive professional looking cases in two-tone grey matt finish

- Rugged Construction
- Ideal for MP systems, Floppies, etc.
- Accepts Eurocard & Verocard systems
- Pre-drilled for card guides (optional)
- Supplied packed flat
- Inc. assembly instructions, nuts, bolts
- Feet Included
- **£7.50** (P&P + VAT included)

or send SAE for component list

SAPPHIRE ELECTRONICS
1, Ramsey Terrace
Otley, Leeds LS21 1AW

(Allow 28 days for delivery)

MK 14 ACCESSORIES — Kits. 20 Key keyboard £11, ½ inch display £16, cassette interface £7.20, re-decoding (64K expansion) £7.74, 4K RAM card £55, with 1K £27.30, 16 bit LED board £11.41, 8 bit LED board £7.10, 1½ amp PSU & 2708 supplies £23.06 + £1.50 p&p, Z80 conversion with interpreter, £34.48, PROM PSU for conversion £8.19, 21 column dot matrix printer mechanism £79.85 + £2.00 p&p, printer control card £69.85, 2 x 32 way edge connector £3.60, 16 way £2.00, MK14 book 216 pages £6.30. Send SAE for details. Redditch Electronics, 21 Ferney Hill Ave, Redditch, Worcs, B97 4RU.

TRITON L5.1, 4K on board RAM, fully cased, plus Motherboard with one filled 8K RAM card, cased. Games tapes, e.g. 8K 3D Labyrinth etc. Complete with all documentation. Sacrifice at £385. Tel. No: Douglas, I.O.M. 0624-23229.

ZX80 PROGRAMS. Star-trek, biorhythms, roulette, tower of Brahama, dice, Simon. all on one cassette. Each fits 1K. £2.50. J. Peart, 45 Kingsgate Terrace, Hexham, Northumberland.

SS50 BUS

Micro-Trainer 2. A complete disc based developement — teaching station built and tested with software £1,100

PCB's available separately built & tested:

Processor Card	£95
Memory mapped VDU with U/L case and graphics	£95
32k dynamic RAM card	£195

Heavy duty mother board, disc controller card, real-time clock plus interface card.

All prices exclude VAT
SAE for leaflet

HEWART MICROELECTRICS
95 Blakelow Road,
Macclesfield, Cheshire
Tel: 0625 22030

SUPERBOARD II

STILL the best value in Home Computers. Just compare the features:

- 8K floating point BASIC in ROM
- Full ASCII keyboard
- Standard cassette/TV interface
- RS232 printer interface
- 4K user RAM
- Expandable to 32K & dual mini floppy.

AVAILABLE **NOW** from:

C.T.S.
31/33 Church Street
Littleborough, Lancs.
Please ring or write for latest prices.
Tel: Littleborough (0706) 74342 any time.

EXCLUSIVELY FROM COMPUT-A-CROP
Mains Interference Filter Units
Price £97.50 + VAT + £5 p + p.
Quantity Discounts Available
Delivery 28 days.
Cash with order to:
COMPUT-A-CROP,
32, Whitworth Road, London SE25.
Phone: 01-771-0867 / 499-6987.
Telex: 893179 COMPUT G.

FOR SALE. Little used professionally built Microtan 65, complete with alphanumeric keypad, documentation and power supply. All in As New condition. £50. Phone Botley 6051.

TRITON, Cased, L4.1 BASIC with expansion Motherboard, 19K in all. £400. Also unused large keyboard 8K PET £425. 679-1698.

ZX80 PROGRAMS

Four programs for the 2 Kbyte ZX80 on one tape
Hangman: with rewritable vocab. up to 50 words
TicTacToe: well-known Os and Xs
Reversi: play with ZX80 to flank each other's discs, flip them over to capture
Squares: mathematical version of Dots
All four, with instructions, for £5.00, incl. p&p
SAE for details of other games and maths programs, most for 1 Kbyte ZX80.
ECONOSOFT 4 The Loont, Winsford, Cheshire

ITT2020 SOFTWARE APPLE II

DATABASE is a program that writes a program. DATABASE can create a flexible record-keeping system custom designed to **YOUR** specification.

HUNDREDS OF APPLICATONS **MEMBERSHIP DETAILS MEDICAL RECORDS MAILING LISTS, ETC**

a direct replacement for the **CARD INDEX**

Simply draw the format you require on the screen using the editor. Then let the computer do the rest! Easy to use. FEATURES: protected screen editing, automatic date and number checking, comprehensive search & print functions.

£120 + VAT for the complete system!
Phone 01-242-7394 or write for details

DISK DEAN LTD
23 BEDFORD ROW, LONDON WC1R 4EB

SPECIAL—ONCE IN A LIFETIME OFFER!

RRP £740

48K **£499** VAT

EXIDY SORCERER

For Personal or Business Use.
32K or 48K memory. 8K Microsoft Basic in ROM. Dual Cassette I/O. RS232 I/O. Parallel I/O (Centronics). Expansion available through optional extra S100 Motherboard. 69 Key keyboard including 16 key numeric pad.

BITS & BYTES

8MHz Super Quality Modulators	£4.90
6MHz Standard Modulators	£2.90
C12 Computer Grade Cassettes	10 for £4.00
Anadex Printer Paper — 2000 sheets	£25.00
Floppy Discs 5¼" Hard and Soft Sectored	£3.50
Floppy Disc Library Case 5¼"	£3.50
Verocases for Nascom 1 & 2 etc.	£24.90
Keyboard Cases	£9.90

NEW REDUCED PRICES

8K **£399**
16K **£499** + VAT
32K **£599**

RRP £795 for 32K

The PEDIGREE PETS

Cassette Deck **£55** extra

Interface PET IEEE — Centronics Parallel
Not decoded **£49.00** + VAT Decoded **£77.00** + VAT

only **£349** + VAT

TRS80 LEVEL 2 16K

Full Range of Software Available

Interface to Centronics Parallel for TRS80 **£75.00** + VAT

only **£295** + VAT

TRS80 EXPANSION INTERFACE

32K

EXATRON STRINGY FLOPPY FOR TRS80

(Expansion interface not needed)

only **£169** + VAT

High Speed storage medium that is cheap and reliable. Includes 20 wafers. M/C monitor. BUS EXPN cable. **£169**

video 100

12" BLACK & WHITE LOW COST VIDEO MONITOR

only **£79** + VAT

- Ideal for home, personal and business computer systems
- 12" diagonal video monitor
- Composite video input
- Composite video input
- Compatible with many computer systems
- Solid state circuitry for a stable & sharp picture
- Video bandwidth 12MHz + 3DB
- Input impedance 75 Ohms
- Resolution 650 lines Minimum In Central 80% of CRT. 550 Lines Minimum beyond central 80%

NOW IN STOCK SUPER 80 COLUMN PET

only **£825** + VAT

SPECIAL SCOOP

GET YOURSELF A PRINTER FOR YOUR PET AND SAVE A FORTUNE

only **£349** + VAT

Full Pet Graphics including cables. Ready to go.

EX-STOCK.

MEMORY UPGRADES

16K (8 x 4116) **£29.90** + VAT

4K Compukit (8 x 2114) **£29.90** + VAT

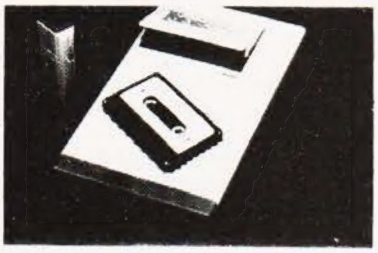
We now have in stock demonstration models of the Atari 800 and Texas 99/4. **Come and see them**

YOU NEED NEVER MISS AN IMPORTANT CALL AGAIN TWO CORDLESS TELEPHONE SYSTEMS — DIRECT FROM USA

THE ALCOM

only **£147** + VAT

Base station connects to your telephone line. Remote handset clips to your belt and gives you push-button dialling — Bleeps when call arriving — Nicad rechargeable batteries. Charger in base unit.



LOW COST TELEPHONE ANSWERING MACHINE

only **£99.95** + VAT

Microprocessor controlled answering machine. Plug into your phone line. Records any phone call messages. Remote bleeper enables you to listen to your messages from anywhere in the world. Uses standard cassettes. Comes complete with mains adaptor, microphone, remote bleeper, base unit, cassette with 30 sample pre-recorded messages.

EUROPE'S FASTEST SELLING ONE BOARD COMPUTER

COMPUKIT UK101

★ 6502 based system — best value for money on the market ★ Powerful 8K Basic — Fastest around ★ Full Qwerty Keyboard ★ 4K RAM Expandable to 8K on board ★ Power supply and RF Modulator on board. ★ No Extras needed — Plug in and go. ★ Kansas City Tape Interface on board. ★ Free Sampler Tape including powerful Dissassembler and Monitor with each Kit. ★ If you want to learn about Micros, but didn't know which machine to buy then **this is the machine for you.**

40 pin Expansion Jumper Cable for Compukit expansion **£8.50** + VAT

Build, Understand and Program your own Computer for only a small outlay.

KIT ONLY **£179** + VAT
NO EXTRAS NEEDED

Available ready assembled, tested & ready to go **£229** + VAT

NEW MONITOR FOR COMPUKIT UK101

- In 2K Eprom 2716
- Allows screen editing
- Saves data on tape
- Flashing cursor
- Text scrolls down **£22.00** + VAT

FOR THE COMPUKIT

Assembler/Editor	£14.90
Screen Editor Tape	£5.90

Game Packs

1. Four Games	£5.00
2. Four Games	£5.00
3. Three Games 8K only	£5.00

Super Space Invaders (8K)	£6.50
Space Invaders	£5.00
Chequers	£3.00
Real Time Clock	£3.00
Case for Compukit	£29.50

All Prices exclusive VAT

HITACHI PROFESSIONAL MONITORS

9" — ~~£129~~ **£99.95**
12" — ~~£199~~ **£149**

- **Reliability** Solid state circuitry using an IC and silicon transistors ensures high reliability.
- **500 lines horizontal resolution** Horizontal resolution in excess of 500 lines is achieved in picture center.
- **Stable picture** Even played back pictures of VTR can be displayed without jittering.
- **Looping video input** Video input can be looped through with built-in termination switch.
- **External sync operation** (available as option for U and C types)
- **Compact construction** Two monitors are mountable side by side in a standard 19 inch rack.

NASCOM 2 DISC DRIVES

Add a powerful, double density, mini floppy disc to your Nascom system.

- Disc Controller Card (includes Nasbus 6 S100 interface
- Will control 4 Drives
- CPM operating system
- Extended Disc Basic Compiler
- Power supply included

One Disc System — **£499** + VAT
Additional Disc Unit — **£299** + VAT

SPECIAL OFFER

We will part exchange your Sinclair ZX80 for any of our products.

Refurbished ZX80's—fully guaranteed **£69.90** + VAT
(Supply dependant upon stocks).

NEW TV GAME BREAK OUT

Has got to be one of the world's greatest TV games. You really get hooked. As featured in ETI. Has also 4 other pinball games and lots of options. Good kit for up grading old amusement games.

MINI KIT — PCB, sound & vision modulator, memory chip and de code chip. Very simple to construct **£14.90** + VAT
OR PCB **£2.90** MAIN LSI **£8.50**. Both plus VAT

We have one of the largest collections of Computer Books under one roof, along with racks of software for the PET and TRS80.
Come and see for yourself.

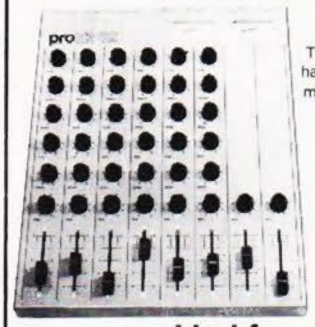
NOBODY CAN GET NEAR OUR PRICES EXCEPT OUR CUSTOMERS

JUST COMPARE OUR CASH AND CARRY PRICES!

COMP PRO MIXER

Professional audio mixer that you can build yourself and save over £100.

6 into 2 with full equalization and echo, cve and pan controls. All you need for your own recording studio is a stereo tape or cassette recorder.



This superb mixer kit has slider faders, level meters and additional auxiliary inputs.

Only **£99.90** plus VAT for **complete** kit. Plus **FREE** power supply valued at £25.00

Ideal for DISCOS STAGE MIXING HOME STUDIOS AND MANY OTHER APPLICATIONS

FULL RANGE OF ACCESSIT AUDIO ADD-ONS

THE ATARI VIDEO COMPUTER GAMES SYSTEM £83.00 + VAT

Atari's Video Computer System now offers more than 1300 different game variations and options in twenty Game Program™ cartridges!

Most Cartriages only £13.90 + VAT

Prices may vary with special editions Basic Maths, Airsea Battle, Black Jack, Breakout, Surround, Spacewar, Video Olympics, Outlaw, Basketball, Hunt & Score*, Space War, Sky Diver, Air Sea Battle, Codebreaker*, Miniature Golf.

Extra Paddle Controllers — £14.90 + VAT *Keyboard Controllers — £16.90 + VAT

SPACE INVADERS NOW IN STOCK £25

EPROM 2716 £12.50 + VAT

WE ARE NOW STOCKING THE APPLE II EUROPLUS AT REDUCED PRICES

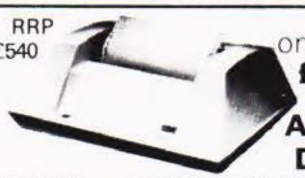
16K **£599**
32K **£649**
48K **£690**
} + VAT

Getting Started APPLE II is faster, smaller, and more powerful than its predecessors. And it's more fun to use too because of built-in features like:

● BASIC — The Language that Makes Programming Fun. ● High-Resolution Graphics (in a 54,000-Point Array) for Finely-Detailed Displays. ● Sound Capability that Brings Programs to Life. ● Hand Controls for Games and Other Human-Input Applications. ● Internal Memory Capacity of 48K Bytes of RAM, 12K Bytes of ROM; for Big-System Performance in a Small Package. ● Eight Accessory Expansion Slots to let the System Grow With Your Needs.

You don't need to be an expert to enjoy APPLE II. It is a complete, ready-to-run computer. Just connect it to a video display and start using programs (or writing your own) the first day. You'll find that its tutorial manuals help you make it your own personal problem solver.

RRP £540



only **£399** + VAT

ANADEX DP8000

Super Quality — Low cost printer. Tractor Feed with full 96 ASCII character set. Accepts RS232C at band rates between 100 and 9600 and Parallel Bit data.

Attaches either directly or through interfaces to Pet, Apple, TRS80, Sorcerer, Nascom, Compukit etc.

NEC SPINWRITER

only **£1490** + VAT

NEC's high quality printer uses a print "thimble" that has less diameter and inertia than a daisy wheel, giving a quieter, faster, more reliable printer that can cope with plotting and printing (128 ASCII characters) with up to five copies, friction or tractor fed. The ribbon and thimble can be changed in seconds. 55 characters per second bidirectional printing — with red/black, bold, subscript, superscript, proportional spacing, tabbing, and much, much more.

NASCOM 2 GAMES TAPE

featuring Space Invaders and Android Nim, Re-numbering program and other goodies!

£7.50 + VAT

THE NEW ANADEX DP9501

A PROFESSIONAL PRINTER

- Bi-directional printing
- Up to 220 chars/line with 4 print densities
- 500 char buffer
- RS232C and Centronics Parallel interface built in
- Full software control of matrix needles allowing graphics capability
- 200 chars/sec ● Adjustable width tractor feed.

All this for only **£895** + VAT.

COMMERCIAL ● EXPANDABLE ● COMPLETE TRS 80 · MODEL II

COMING SOON 26 megabyte Hard Disc multi-user DOS

This new unit from the world's most successful micro company is now available immediately with software.

The basic unit comes complete with 64 thousand characters (bytes) of Memory. The built in 8" Floppy disc adds another ½ million extra characters including the disc operating system. More disc expansion is now available.

The Model II is a complete unit with a full keyboard including a numeric pad and 12" screen which gives 24 lines of 80 characters. The computer is supplied with both the disc operating system and the Level III Basic.

A full self test routine is written into the power up procedure to eliminate incorrect operation. Both serial and parallel expansion sockets are standard. A printer is a plug-in operation.

Both hardware and software necessary to talk to a mainframe are included. Terminal usage is very possible. With the addition of CPM2 you can operate with COBOL, FORTRAN, MBASIC, CBASIC in which languages are many other applications packages i.e. accounting, payroll stock etc.

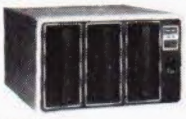
64K 1-Disk Model II **£1995.00** + VAT

RRP £2250.00

WE USE THIS MACHINE IN OUR BUSINESS

1 DISK EXPANSION Room for 3

500K per Drive gives total of 1.5M Byte — 1 Drive plus Cabinet **£799** + VAT



CP/M2	**£95.00**	C BASIC	**£75.00**	FORTRAN	**£220.00**
CIS COBOL	**£400.00**	M BASIC	**£155.00**	WORDSTAR	**£255.00**

NOW OPEN

OUR *NEW* SHOWROOM & SALES CENTRE AT

311 Edgware Road, London W2.

Telephone: 01-262 0387

COMPUTER/SALES ENGINEERS REQUIRED

Contact Bill Wood (Chief Engineer)

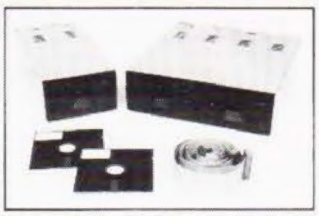
We give a full one year's warranty on all our products.

ENGLISH COLOUR TV/ AMERICAN NTSC COLOUR MONITOR

Suitable for Apple, Atari and Texas 99/4

£295 + VAT

TEAC DISK DRIVES



- TEAC FD-50A has 40 tracks giving 125K Bytes unformatted single density capacity.
- The FD-50A can be used in double density recording mode.
- The FD-50A is Shugart SA400 interface compatible.
- Directly compatible with Tandy TRS80 expansion interface.
- Also interfaces with Video Genie, SWTP, Heathkit, North Star Horizon, Superbrain, Nascom, etc, etc.
- Address selection for Daisy chaining up to 4 Disks.
- Disks plus power supply housed in an attractive grey case.

Single Disk Drive **£225** + VAT Double Disk Drive **£389** + VAT

COMP SHOP

"Europes Largest Discount Personal Computer Stores"

Please add VAT to all prices — including delivery. Please make cheques and postal orders payable to **COMPSHOP LTD.**, or phone your order quoting **BARCLAYCARD, ACCESS, DINERS CLUB** or **AMERICAN EXPRESS** number.

CREDIT FACILITIES ARRANGED — send S.A.E. for application form.

MAIL ORDER AND SHOP:
14 Station Road, New Barnet, Hertfordshire, EN5 1QW *(Close to New Barnet BR Station — Moorgate Line).*
Telephone: 01-441 2922 (Sales) 01-449 6596 Telex: 298755 TELCOM G

NEW WEST END SHOWROOM:
311 Edgware Road, London W2. Telephone: 01-262 0387

OPEN — 10am - 7pm — Monday to Saturday

- **IRELAND:** 80 Marlborough Street, Dublin 1. Telephone: Dublin 749933
- **COMPSHOP USA,** 1348 East Edinger, Santa Ana, California. Zip Code 92705. Telephone: 0101 714 5472526

BARCLAYCARD VISA AMERICAN EXPRESS DINERS CLUB INTERNATIONAL

COMP COMPUTER COMPONENTS
(Part of the Compshop Ltd. Group)

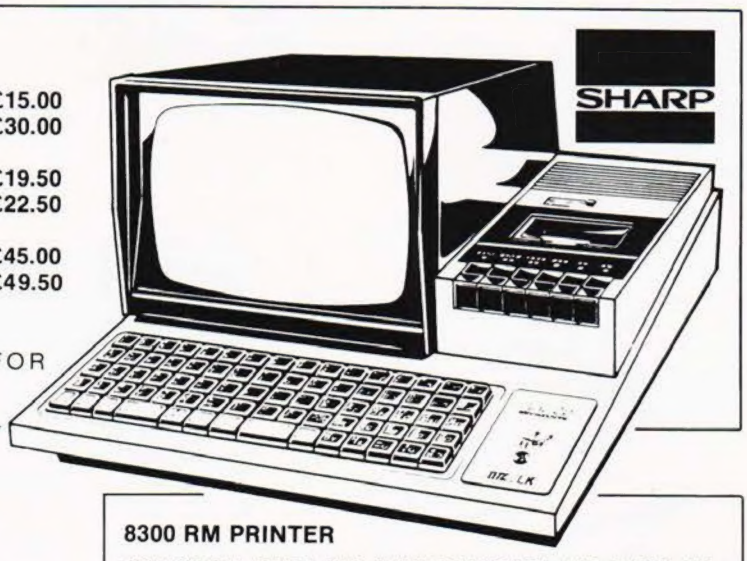
NewBear
Computing Store Ltd

MZ-80K

NBMZ80K MONITOR LISTING	£15.00
NBMZ80K BASIC LISTING	£30.00
NBMZ80K ZEN EDITOR/ASSEMBLER TAPE & MANUAL	£19.50
MZ80K MACHINE CODE TAPE & MANUAL	£22.50
MZ80K ASSEMBLY LANGUAGE TAPE & MANUAL	£45.00
NBMZ80K V24/RS232 PRINTER INTERFACE	£49.50

DISKS & PRINTER NOW AVAILABLE

A COMPLETE BUSINESS SYSTEM FOR **LESS THAN £2000.**



MICROCOMPUTING I.C.'S

MC6800	£6.75
MC6802	£10.50
MC6809	£17.75
MC6810AP	£3.61
MC6821	£4.63
MC6840	£10.50
MC6850	£4.99
MC6852	£4.75
MC8062P	2.88
MC14536P	£2.50
MC3459	£2.43
Z8001	£142.50
Z80 CPU 2.5 Mhz	£8.99
Z80 CTC 2.5 Mhz	£7.99
Z80 P10 2.5 Mhz	£7.99
Z80 S10	£25.57
Z80A CPU 4 Mhz	£10.50
Z80A P10 4 Mhz	£10.00
Z80A CTC 4 Mhz	£10.00
SC/MP 11 (INS806ON)	£11.30
INS8154N	£8.18
6502	£8.99
6522 VIA	£8.14
6532	£9.75
6545 CRT CONTROLLER	£18.50
6551 ACIA	£9.99
8080A	£5.50
8224	£2.95
8228	£3.00
DM 8835N	£1.35
8212	£2.25
8216	£2.50

NEW LOW PRICES!

apple computer

NORTH STAR ★ HORIZON

8300 RM PRINTER

80/132 CH PER LINE (SWITCHABLE); 125 C.P.S: 2K BUFFER; V24 RS 232/ CURRENT LOOP INTERFACE; SPEED SWITCHABLE BETWEEN 110.9600 BAUD; VARIABLE WIDTH CHAR AVAILABLE UNDER SOFTWARE CONTROL: SPROCKET FEED; 4 x 9 DOT MATRIC; PAPER WIDTH 4.5" TO 9.5"

PRICE £499.00

SPECTRONICS U.V. EPROM — ERASING LAMPS

PE 14	ERASES UP TO 6 CHIPS, TAKES APPROX. 19 MINS.	£45.00
PE 14T	ERASES UP TO 6 CHIPS, TAKES APPROX. 19 MINS.	£59.95
PE 24T	ERASES UP TO 9 CHIPS, TAKES APPROX. 15 MINS	£87.00
PR 12ST	ERASES UP TO 16 CHIPS, TAKES APPROX. 7 MINS.	£186.24
PR 320T	ERASES UP TO 36 CHIPS, TAKES APPROX. 7 MINS.	£302.00

U.V. EPROM ERASING CABINET

PC 1100	ERASES UP TO 72 CHIPS, TAKES APPROX. 7 MINS.	£693.00
PC 2200	ERASES UP TO 144 CHIPS, TAKES APPROX. 7 MINS.	£1142.00
PC 3300	ERASES UP TO 216 CHIPS, TAKES APPROX. 7 MINS.	£1595.00
PC 4400	ERASES UP TO 288 CHIPS, TAKES APPROX. 7 MINS.	£2047.00

proper 816

PROFESSIONAL PROM PROGRAMMER FOR 2708/2716/2532

PRICES FROM £565.00
SEND FOR FULL SPECIFICATION.

NewBear

for the widest selection of computing books

NEW BOOK LIST

MEMORIES

4116 (16K DYNAMIC)	£4.50
2716 (INTEL + 5V TYPE) -	£12.50
2708	£4.50

GET A SHARP DEAL FROM NEWBEAR

SEND FOR OUR FREE CATALOGUE

NEWBEAR COMPUTING STORE LTD, (HEAD OFFICE) 40 BARTHOLOMEW STREET, NEWBURY, BERKS
TELEX 848507 NCS (MAIL ORDER) **TEL. (0635) 30505**
FIRST FLOOR OFFICES, TIVOLI CENTRE, COVENTRY ROAD, BIRMINGHAM. TEL. 021 707 7170
220-222 STOCKPORT ROAD, CHEADLE HEATH, STOCKPORT. TEL. 061-4912290

PLEASE ADD V.A.T. TO ALL PRICES.